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THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

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CONTENTS.

☞ An asterisk (*) denotes an illustrated article

EDITORIAL—
The Price of Gas.....111
"Righteousness Exalteth a Nation, but Sin is a Reproach to any People."....111
Illuminating Power.....111
Foul Lime.....112
The Municipal Oxygen Gas Company.....112
Hoisting Apparatus.....112
New England Association of Gas Engineers.....112
Salt Water for New York.....112
Price of Gas.....112
Sugg's Illuminating Power Meter.....112
Foul Lime Purification—How to do away with the Nuisance of It.....113
United States Hoisting and Conveying Company.....114
Paterson vs. The Gas Light and Coke Company.....115
The Delta of the Mississippi Valley Considered in Relation to an "Open Mouth River."....118
The Position of Dry Gas Meters.....120

CORRESPONDENCE—
The Lowe Gas Process.....120
Letter from Magnus Ohren.....120
Gas Enricher.....120

Gas-Light Intelligence.....120

CHEMICAL AND SCIENTIFIC REPERTORY—.....121

Rope Transmission in Mills.....121
Kanawha Splint Coal.....122

WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

Subscribers would confer a favor upon us by remitting *CHECKS*, or *POST OFFICE MONEY ORDERS*, as we are frequent losers where money is enclosed in letters.

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NOTICE.

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☞ THE PRICE OF GAS.—We desire to publish, at as early a date as possible, a correct list of the prices at which gas is sold by the various companies throughout the United States and Canada; and we would respectfully ask that each company would send us by postal card the price at which they are selling. In this way the information will be reliable, and gas managers throughout the country can see at a glance what the prices are in other places.—ED.

"RIGHTEOUSNESS EXALTETH A NATION, BUT SIN IS A REPROACH TO ANY PEOPLE."

Deprecating as we do "the Trial by Newspaper," we must refrain from any remarks as to the recent developments at Washington. But we cannot but express the regret which we are confident is felt by every true American, that there should exist such a state of things as would render it possible for any one to believe that there could be a foundation for the many sad rumors that are current to-day. Leaving all *personalities* out of the case, it is by far too commonly believed that other considerations than fitness and usefulness have weight, and are employed, in carrying on the various functions of the Government. Nor is it in Government affairs alone that we hear rumors of the power of that wonderful quality, which is so lightly spoken of as "Division and Silence." It is high time that every man (and every woman too) who has regard for his or her own security and honor, should put far from them those who posses, even in the slightest degree, this degrading, dishonorable, and demoralizing propensity. Sad, indeed, will be the hour when legitimate business cannot be conducted in an honest and honorable way.

When it comes to that, then it becomes honest to steal, truthful to lie, and honorable to dishonor the family. To none is it more important to watch against the slightest approach of this evil, and crush it if it appears, than to those occupying positions of trust, and we use this latter term in no *narrow* sense. Any man who is employed to look after and advance the interest of another is in a position of trust, whether that interest is corporate or private.

The time has come when the lines should be drawn closely and exactly. It is no time for calling things by other than their right names. He that appropriates to his own use (or to the benefit of a friend) that which does not lawfully belong to him—STEALS. This is a hard word to apply to any one, but "as a man makes his bed so shall he lie on it"; and, unless there is something of a return to the use of some few good old Saxon words, it is to be feared that their full meaning and application may be lost.

The time has now come when any man that is found "with his hand thrust out behind him," should have that hand pierced with the arrow of public scorn, and forever marked as one not to be trusted.

Honest deeds need no concealment, no mystery. Division is a mathematical term, and used to be defined as a short method of performing subtraction in mathematical operations; but of late it has acquired an application to other operations which is most woeful in its consequences.

It is to be most ardently wished that every one will carefully survey *himself* in this matter. It is not necessary to look after any one else, but let every man balance his own account, and begin afresh, and remember the meaning and the comprehensiveness of some of those old Saxon words and good must result from it. They are words of one syllable, easily remembered if we only half try, and, if remembered, must do more to redeem the times than anything else that could be done. With this simple test for every action, we shall soon see a change in affairs, public and private, and shall no longer be obliged to blush for ourselves or our friends, for—

"Righteousness Exalteth a Nation, but Sin is a Reproach to any People."

ILLUMINATING POWER.

We republish, from the London *Journal of Gas-Lighting*, the main points of a lecture delivered before the Institution of Civil Engineers, in London, on 15th of last month, by Mr. William Sugg, upon the testing of the illuminating power of gas. This is one of the most vital points to the gas-maker, and one that we feel bound to say is either not fully understood or not carefully practiced.

The trouble in the whole matter is simply here—When one speaks of gas as being such and such candle power, it does not convey any definite idea even to those familiar with the business, for the reason that every man has a "*standard*" burner of his own; and after he has stated the candle power of his gas, it is necessary to inquire whether it is determined by jet photometer or not; if by a bar photometer then—what burner do you use, etc.?

By the article that we refer to above t will be

seen that even in England, where they have a legal standard burner, they are also perplexed from the fact that they have several of these, and now Mr. Sugg, who has probably given as much study to this subject as any one in England, proposes to establish another means of comparison. This is a subject which should be taken in hand by the Gas Engineers of America, for here we have no legal standard burner.

We would not advocate any legislation on this subject, at least for the present; but we would suggest that, at the next meeting of the American Gas-Light Association, this matter be referred to a committee of the ablest engineers in the country, and that they be empowered to make experiments, gather information as to what has been done elsewhere, and propose a standard burner which shall be used in describing the quality of gas in this country hereafter. It does not follow that any better burners than those already invented can be devised for this purpose; but what is wanted is some one burner that can be used by mutual consent, and that will give a definite standard of comparison, so that when two men are talking about the candle power of gas, they will feel some degree of certainty that they are referring to the same thing as a standard.

One thing should be born in mind in the consideration of this subject, and that is that gas is a commercial commodity, and the burner should be adapted to the gas ordinarily manufactured.

We often hear it stated that in testing the illuminating power of gas that it is no more than fair to give it (the gas) the advantage of the best burner that can be found for the particular gas in question.

This is true as regards the consumption of gas, but for means of comparison, by different persons who are engaged in the manufacture of gas, and who wish to compare their workings and their results, it is necessary that an absolute and invariable standard should be adopted. The proper men to determine this standard are the gas-makers; and we would suggest that those who desire to advance the real interest of their business give this matter careful study.

We shall watch with interest for the full report of Mr. Sugg's lecture, which we hope to give our readers at a later day. The apparatus necessary for making photometrical experiments has been brought to a great state of perfection in this country; and, in some that we have seen, the successful application of electricity has enabled a single operator to terminate his test instantly, thus removing some of the liabilities to error.

What is wanted now is a *Standard Burner;* but, before we adopt a standard, let us understand what we need, and agree upon such a one as will be satisfactory in its results.

FOUL LIME.

We publish to-day a description of the method adopted by one of the companies of this city for deodorizing foul lime, so as to avoid the disagreeable odors that arise from the purifying boxes at the time of changing. In many smaller works, of course, in more thinly settled communities the amount of lime used is comparatively small; but when used in large quantities, in crowded localities, it becomes necessary to protect the neighborhood by all reasonable means within the power of the company. Such is the case described, and the treatment of the case has been successful and satisfactory, not only to the residents in the vicinity, but to the Board of Health. We are glad to be able to record the details, as given by our correspondent, as they may be of service to the managers of works elsewhere.

THE MUNICIPAL GAS COMPANY.

The following is a list of the officers and directors of this company: R. M. C. Graham, President; Peter Gardner, Peter H. Watson, Geo. W. Gilbert, William Schwarzwalder, Geo. W. King, Charles G. Francklyn, Theodore Weston, Thomas F. Rowland, Directors; Samuel J. Young, Secretary; Thos. W. Collins, Engineer; E. Baron Jerzmanowski, Consulting Engineer. The capital stock is $500,000. The company is now making gas under the Tessie du Motay patent, at their works, foot of 41st street and North River. About two weeks ago they lighted the Gilsey House, and since then have introduced their gas in two or three other places. We understand that the intention is to demonstrate the practicability of making gas by this process, and that they are furnishing a gas of about twenty candle power, of a specific gravity of about ·650 or ·670. The price charged at present is the same as that of other companies.

HOISTING APPARATUS.

The illustration which we give on another page, of a machine for hoisting, etc., shows one of the best modes of handling coal by machinery that we have ever seen. Its simplicity is remarkable, and yet its efficiency is unquestionable. The machines, in both forms, have been in use at the 18th Street Station of the Manhattan Company's works for some time, and quite a number of gentlemen connected with large interests in this vicinity have visited the works recently to witness the operation of handling coal by means of them—which has proved satisfactory in every case.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

We have received a portion of the report of the proceedings of the New England Association of Gas Engineers, but it was too late for this issue. In our next we hope to be able to give our readers a full synopsis of the Proceedings.

Salt Water for New York.—There is considerable talk just now about pumping salt water for use of fires, flushing sewers, etc. It seems that no scheme is too wild too gather advocates. No pumping system can be always relied on. The Chicago fire happened to burn the water works, and they were useless. In many places no other system can be used, and there it is the best to be had. We are now using but one-fourth of the Croton supply, the rest going to waste. What is wanted is a system of larger pipes and mains, and the means of availing ourselves of what we have, and not a complication of systems. The fresh water will do everything that salt water will do, but the salt water cannot be used where fresh water can. As to flushing sewers they now are flushed with 100 millions of gallons a day.

The Price of Gas.—In reply to our request in the last number of the Journal, we have received quite a number of answers. We hope that *all* those who have not yet sent us the price at which they sell gas, will not fail to do so at as early a day as possible. It is proposed to continue the list so as to make the record complete.

Sugg's Illuminating Power Meter.

At the Meeting of the Institution of Civil Engineers, on Tuesday, Feb. 15—Mr. G. R. Stephenson, President, in the chair—the Paper read was "On Estimating the Illuminating Power of Coal Gas," by Mr. William Sugg, Assoc. Inst. C. E.

It was observed that, notwithstanding the attention which had been bestowed upon the subject, gas photometry was still in an unsatisfactory state. With even the most perfect apparatus, the same quality of gas was differently estimated in different places, because there was no generally recognized standard burner. The jet photometer originally invented be the late Mr. George Lowe, M. Inst. C. E., had been so improved, that it was possible to ascertain, by simple inspection, the true illuminating power capable of being evolved from different coal gases.

It was generally acknowledged that the most accurate way of estimating the illuminating power of gas was by burning a known quantity of that gas in a standard burner, and comparing the light with that from a known quality of oil or sperm, consumed in a certain kind of lamp or candle. In England, since the year 1852, the parliamentary standard of comparison had been a sperm candle, of six to the pound, burning at the rate of 120 grains per hour; but the average normal rate of burning of these candles was nearer 130 grains than 120 grains. Therefore, it was desirable that the parliamentary standard rate should be altered, if a change could reasonably be made. The greatest obstruction to the adoption of a uniform system of gas photometry had always been the difficulty of settling the kind of burner with which the gas should be tested. With the standard quantity of the same gas, different kinds of burners gave different results; and the same burner gave different results with the same standard quantity of gases of different illuminating powers, richer or poorer, according to the kind of gas it had been originally designed for. In 1863, Dr. Letheby designed, in conjunction with the author, a standard burner with a 15-hole incorrodible steatite top. Previous to this all burners had iron tops, which were subject to alteration by oxidation. This burner, known as the "Sugg-Letheby" 14-candle burner, was one of the Parliamentary standard testing burners for 14-candle gas, and was used, with a chimney 7 inches long and 2 inches wide, in some parts of North and South America, in Canada, Australia, and New Zealand. There were, however, two other parliamentary burners for 14-candle gas—viz., one described in the Birmingham and Staffordshire Gas Act of 1864, for testing the gas supplied to Birmingham, Hanley, Hull, and, lately, Brighton. The other 14-candle burner was that adopted by the Gas Referees for London, in 1869. It was the invention of the author, and was known as Sugg's "London" standard Argand burner for 14-candle gas, and it was used for testing the gas supplied to the city and other parts of London by the Gas-Light and Coke Company, the Imperial Company, the South Metropolitan Company, and by a number of companies in the provinces. It was also the new standard burner for the Dominion of Canada. The same standard quantity of the same quality of gas tested by these three burners showed very different powers of light, the "London" burner evolving the greatest, and the Birmingham the least amount of light. The total difference was nearly 3 candles.

There were three different parliamentary standard burners for testing 16-candle gas, all to consume the standard quantity of 5 cubic feet per hour—viz., the "Dublin" 16-candle Argand 15-hole steatite-top burner, used with a chimney 7 inches long by 2 inches wide; the "Dublin" flat flame 16-candle burner; and the "London" standard Argand for 16-candle gas, with a 24-hole

steatite top, to be used with a chimney 6 inches long and 2 inches wide. There was but one parliamentary standard burner for consuming 5 cubic feet per hour of 18-candle gas—viz., that described in the Leamington Gas-Act, which was a modification of the "Sugg-Letheby" burner, the central aperture being enlarged to supply more air to the richer gas. The "London" 18-candle burner for the standard quantity of the same quality of gas gave an amount of light equal to about 2¼ candles more than the Leamington burner. For 20-candle gas the parliamentary standard burner had been described by the gas referees as Sugg's steatite bat's-wing, No. 7. It was used in London and in Liverpool. For 27 up to 32-candle gas it was customary to make use of any kind of fish-tail burner, and to consume any quantity of gas, at the option of the operator. For cannel gases there was no regularly authorized parliamentary burner.

By the system of the author, one standard burner only was proposed for all qualities of gas from 12 to 30 candles. This burner might be readily gauged and verified by actual trial against the Government standard burner. It was the gas referees "London" Argand burner, with a chimney 6 or 7 inches long, by 1¼-inch wide, producing a flame always 3 inches in height; in fact, such a burner as was ordinarily adopted by consumers. When used with 16-candle gas it would burn 5 cubic feet per hour, with a 3-inch flame, the light from which would be equal to that given by 16 sperm candles of six to the pound. The quantities of different qualities of gas required to produce in burning a 3-inch flame with this burner, were with—

12-candle	gas	.....	6·6	cubic feet.
14	"	"	5·7	"
16	"	"	5·0	"
17	"	"	4·7	"
18	"	"	4·4	"
19	"	"	4·2	"
20	"	"	4·0	"
25	"	"	3·2	"
30	"	"	2·7	"

Eight different sizes of "London" Argand burners were shown, which gave *pro rata* amounts of light for different quantities of gas, varying from 2½ feeet to 7½ feet per hour.

Of late years a Gas Referee's standard burner has been constantly used by the author as a standard light for testing various kinds of gas burners, and it had been found that the illuminating power, as well as the appearance of the 3-inch flame, had been always constant, notwithstanding considerable variations in the quality of the gas. The proposed method for effecting a comparison was as follows:

The Gas Referees 3-inch flame burner having been fixed on a photometer in the place usually occupied by the standard burner, it was lighted and allowed to burn off all the dead gas collected in the meter and fittings of the apparatus. Then a clean chimney was put on, and the height of the flame regulated by the aid of the usual micrometer cock and King's pressure-gauge, to exactly 3 inches. The quantity of gas per hour required to give this flame was then found, and a reference to the table would show the examiner the illuminating power of the gas. The rest of the experiment was performed in accordance with the instructions of the gas referees, and would be a corroboration of the table, and at the same time a check upon the accuracy of the sperm candles, which were very subject to error. The result was illuminating power of the gas in terms of the parliamentary standard quality of 5 cubic feet of gas and 120 grains of sperm candle. Every quality of gas tried upon this system would be fairly consumed, and a like quantity of gas would be designated by the same number of candles of illuminating power.

The paper was illustrated by diagrams and an actual specimen of a new and simple apparatus, the invention of the author, termed an "Illuminating Power Meter," by which the illuminating power of gas could be read off from a dial at once in standard sperm candles. No previous knowledge, either of the manufacture of gas, or of its chemical composition, or of the mode of testing it, was requisite for the use of this novel instrument.—*London Journal of Gas-Lighting.*

[Original Communication.]
WRITTEN FOR THE AMERICAN GAS-LIGHT JOURNAL.

Foul Lime Purification—How to Do Away with the Nuisance of It.

In works where the dry lime process of purification is used, there are often complaints made—sometimes by individuals, sometimes by the authorities, the Board of Health, or such other functionaries as may be especially charged with the care of the sanitary condition of cities and towns, "that gas-works are a nuisance" inasmuch as the smell from the purifying house, or the waste products thereof, is intolerable.

Of course the larger the works and the more thorough the purification, the larger will be the quantity of "foul lime," and the more disagreeable the odor thereof; and hence the greater necessity for especial provision to guard against the evil complained of when the complaint is a just one.

Thinking that the course of proceedure pursued by our company is a satisfactory solution of the difficulty, and knowing that, so far as we are concerned, no nuisance can now be said to result from "changing purifiers," I give your readers the benefit of our experience, trusting that it may be for the public good, and that it may serve to remove one of the strongest objections that can be urged against the dry lime process.

I do not propose to discuss the chemical theory of this matter, feeling confident that an assurance of the fact, that the means accomplish the end, will be of much more practical importance to gas manufacturers than any long disquisition would be upon the very complicated chemical changes that may or may not take place during the process.

In general terms, the method may be described as drawing atmospheric air down through the foul lime in the box, after the lid is raised, and then passing it through an ordinary spray washer, by means of an exhauster, then forcing this air through a pipe into and through another purifying box without a cover, filled with pulverized foul lifne, and from thence through a tall chimney into the open air.

Our purifying house contains 12 boxes, 17x22, arranged in two parallel lines. From the bottom of each box two 16-inch pipes lead to a 24-inch pipe placed between the two lines of boxes, and leading to an ordinary spray washer (standing in the foul lime house), which is about 5'x10'x9½' high, having eight compartments, arranged so that the air will pass alternately up and down, subject to the action of the water from the spray in each, which is supplied from the general tank. An 8-inch overflow carries off this water after being used. From this washer the 24" pipe continues to a Farmer Screw Exhauster, 5 feet in diameter, running up to 600 revolutions a minute, from thence it is connected with a 24 inch sewer pipe, which leads under the street, about 1,000 feet, to a one story brick building, divided into two rooms about 20 by 30. These rooms have no windows or other opening, save the door and an opening at the top of one end leading into a chimney 75 feet high. In each room there is built up from the floor a brick box about the size of an ordinary purifying box. The 24-inch pipe connects with the bottom of these boxes, and they are arranged to fill with trays, in the same manner as for purifying gas, only the *foul lime* that has had air drawn through it is pulverized, and after being wetted down, is spread on the trays until the box is full. These boxes, or, more properly speaking, bins, are not covered at all, and *fresh* lime spread in them will not answer. The *foul* lime must be used here, or the results obtained are not satisfactory so far as the air passing out of the top of the chimney is concerned.

This is an important fact that was discovered by and adopted at the suggestion of Mr. Carl H. Schultz, chemist, N. Y., and to him, on account of this discovery, are we indebted for the success of the operation.

When it is necessary to change a purifier, the gas being turned off, and the valve of the deodorizing pipe opened, the cover is raised out of the seal about six inches, and the exhauster started. The air is drawn down through the lime in the purifier, through the washer, to the exhauster, and thence forced along to the deodorizing house, where connections by proper valves lead it through one of the bins containing the pulverized foul lime into the room in which it stands—which has been previously sealed up—thence up the chimney to the open air. Sometimes we use a spray of water in this chimney to again wash the foul air.

In this way fresh air is drawn down through the purifying box, for the space of one hour and a-half, which is the time that experiment has shown to be sufficient; then the valves in the pipes leading from the boxes are closed, and a damper, or valve, in the 24-inch pipe just before the exhauster, is opened, and fresh air driven through the exhauster and the deodorizing house for another hour, after which the deodorizing house is opened, and the foul lime in the bin is taken out and sold for agricultural purposes.

It is our custom to change the lime in the deodorizing house for every purifier changed in the purifying-house.

There is one fact in connection with this arrangement that is worthy of notice, viz.: The sewer pipe leading to the deodorizing house is coated (on inside) to the extent of 5 or 6 inches, after a year's use, with crystallized naphthaline, which is removed by introducing a jet of steam and blowing it through by the exhauster.

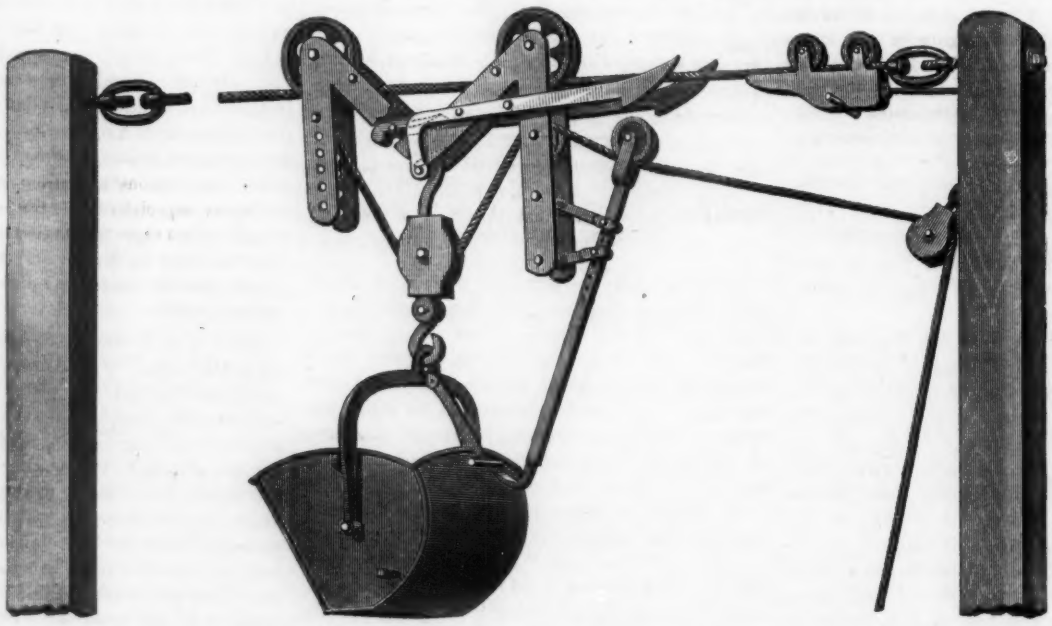
Upon one occasion we filled the washer above referred to with slats, for a better distribution of water, but after deodorizing four or five boxes we were obliged to remove them, because we found that the washer was completely choked with crystallized naphthaline. This would seem to indicate that a large quantity of naphthaline is arrested by the lime in the purifiers, for there is no other source whence it could be derived during this operation.

This method has been followed for a number of years, and since its adoption there has been no complaint of the nuisance of foul lime. While the manufacture of gas is always attended with more or less of "bad smells," smoke, etc., still it is within the power of every engineer to control these to a great extent; and by a little attention to cleanliness and order, it is possible to render the vicinity of a gas works much less objectionable than that of many other manufacturing establishments. There is no excuse for any uncleanness in the surroundings of a well-managed works.

United States Hoisting and Conveying Co.

This company have organized for the purpose of supplying their machines to parties having coal, ores, merchandise, etc., to hoist from vessels and carry to sheds, warehouses, or other receptacles. These machines have been thoroughly tested on a very large scale. They are used either on a wire cable or a track upon trestle work. They are manipulated with the greatest ease by the man in charge of the hoisting engine. One great advantage in handling coal with these machines is, that when the machine has arrived over the dumping point, it is not necessary to dump the coal, and allow it to fall thus breaking it, but the bucket may be lowered any distance and then discharged, all by the same man. There is no spring in any part of the machine, and no part that any ordinary blacksmith cannot repair. All the operations of stopping, raising, lowering, and upsetting the tub are performed by one and the same rope. The upper cut shows the details of the machine, with bucket attached, as arranged for working on a wire cable. The cable is placed at a slight inclination, so that the loaded bucket runs by gravity. The bucket is loaded on the ground, the friction drum is thrown into clutch. As the hoist rope winds up, the bucket is raised till the hook on top of the lower block catches on the machine.

The hoisting rope is fixed to the arm of the machine on the left side, passes through the hoisting block, over the fixed sheave in the arm of the machine on the right side, thence under the sheave of the trip lever, to a fixed swivel pulley block on the yost, thence to the drum (which is not shown), attached to the engine. The dumping tub here shown, suspended to the hook of the hoisting block, can be removed, and anything else desired, used in its place. The lower cut represents the machine arranged to travel on a trestle. The tub can be hoisted from the canal boat, move up the track two hundred or three hundred feet, dump the coal, and return empty to the canal boat inside of two minutes, or at the rate of 300 tons in ten hours.



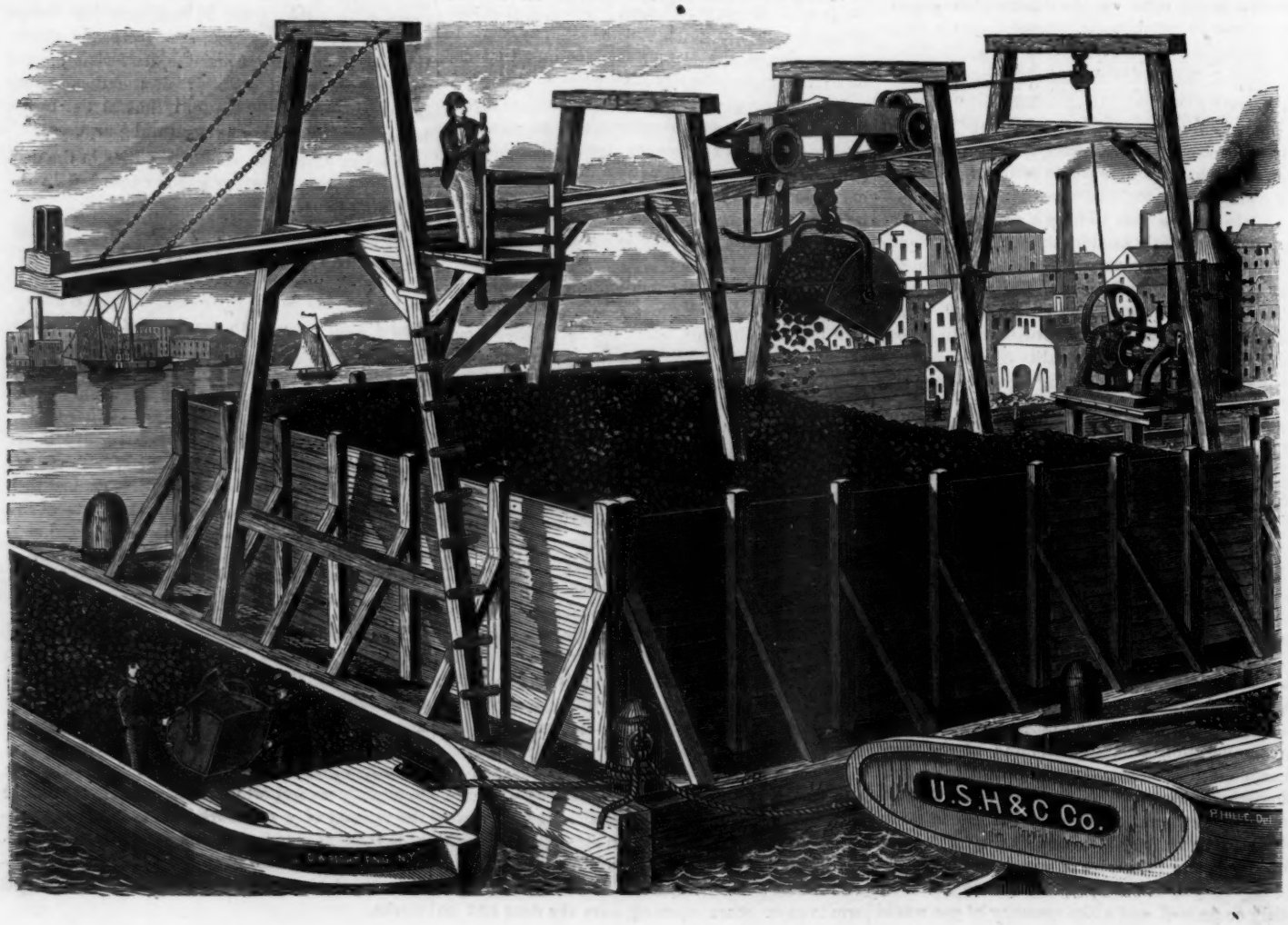
There is a lively enquiry for these machines; they have been sold to go to Japan, and several other distant points. There are numbers in actual operation in this country.

There are 10 or 12 of them used by the Manhattan Gas Light Co. at their works in this city, where their operations may be witnessed any day. They are also used in Jersey City.

The saving in labor in handling material by this method is very great, as will appear to any one upon inspection.

The item of repairs is very small. Where a cable is used, all that is necessary is to have it so arranged that it can be turned about a quarter around occasionally, so as to make the wear upon the strands uniform.

Working models, and full information may be had at the Company's office 115 Broadway, N. Y.



Patterson vs. The Gaslight & Coke Company.

OPINION OF VICE-CHANCELLOR BACON.

The following is the judgment of Vice-Chancellor Bacon, delivered on February 1st, in the above case, the trial of which has been going on for some time in the Chancery Division of the High Court of Justice, London, England. He said: The plaintiff in the suit was the grantee of letters patent dated the 9th of March, 1872, for improvements in the manufacture of coal gas. The defendants were an incorporated company, called The Gaslight and Coke Company, possessing several gas works in and near the Metropolis, in which they carried on the manufacture of gas, and from which they supplied the City of London and other places. The plaintiff alleged that the defendants had infringed the rights granted to him by his patent, by using, at their works, especially at Beckton, a process for the purification of gas identical with, or only colorably differing from, his invention; and he prayed that they might be restrained from continuing such infringement, and that they might account for all the gains they had made by the use of his invention, and pay to him the amount of loss and damage sustained by him in consequence. The defendants disputed the validity of the patent on various grounds, which had been the subject of much argument, and which required to be carefully considered. But at the outset it was sufficient to say that they disputed the novelty of the plaintiff's invention, as to the method of purification described in the specification; they denied that the alleged invention was the proper subject of a patent, they suggested the publication by him of what he called his invention before the date of the letters patent, and they submitted that he was personally disqualified from suing for or obtaining a patent. The main question in the cause was the validity of the patent; but in order to determine the question, it was necessary, as well from the nature of the subject, as from the facts given in evidence, to consider the several grounds on which the plaintiff's claims and defendant's objections were rested. A useful and valuable invention for obtaining artificial light from gas produced from the distillation of coal had been in common practice for more than half a century, and had undergone various improvements, which had engaged the attention of the Legislature, and had sometimes been the subject of litigation. But inasmuch as its great usefulness was not unaccompanied by danger and difficulty, and public and private inconvenience, it had been found necessary, at various times, to lay down rules for its manufacture and supply. It was not necessary to go very minutely into this part of the subject, beyond referring to the Metropolis Gas Act of 1860, by which an inspector was appointed for the purpose of ensuring a supply, by the companies, of gas of a proper quantity and quality, and the companies were required to obey the order of the Secretary of State on the inspector's reports under the penalties thereby imposed. Various other restrictions were imposed on the companies, with a view of compelling them to provide a proper supply of gas within their respective districts. By a more recent statute, the City of London Gas Act, of 1868, into which the former Act was, for the greater part, incorporated, the authority of the Board of Trade was substituted for that of the Secretary of State, and the Board were authorized to appoint three referees, whose duty it was to prescribe the mode of testing the illuminating power of the gas supplied by the companies, with power to inspect the works of the companies, and investigate the processes of manufacture carried on therein, with a view of ascertaining the means adopted for purifying the gas and preventing nuisance, and to apply such test as they might think expedient for ascertaining the amount of sulphur and ammonia, and the compounds thereof, or other impurities with which the gas supplied by the companies might be charged; and to prescribe and certify the maximum amount of impurity with which the gas, when it was issued for public consumption, should be allowed to be charged. It was enacted that the gas should be wholly free from sulphuretted hydrogen, and the referees were forbidden to allow any gas to be charged with any amount of impurity in that form. Several other provisions were made, with a view of enforcing a supply by the companies of gas as efficient and as pure as might be. Under the statute the Board of Trade appointed three referees, of whom the plaintiff was one. They proceeded to discharge the prescribed duties, and became necessarily acquainted with the means, apparatus, and processes employed by the defendants in their manufacture. It was notorious, and it was admitted on both sides, that the effect of distillation from coal was to produce a vapor, which in its first state was charged with varied impurities besides those mentioned in the statute, all of which had to be removed or neutralized before gas could be brought into that condition which rendered it safe and useful for the purposes of public and private illuminating. By processes of condensation, washing, and scrubbing, the crude vapor issuing from the retorts was so dealt with, that the then remaining impurities consisted of carbonic acid, sulphuretted hydrogen, and various sulphur compounds other than sulphuretted hydrogen. It was to the removal of these elements, especially the latter, that the invention of the plaintiff related. The specification, which was of considerable length, described the invention as consisting, first of the purification of coal gas from sulphur in other forms than that of sulphuretted hydrogen, by means of sulphide of calcium, employed in separate purifiers. Secondly, it was said to relate to the principle and process of working lime purifiers, whereby the carbonic acid in the gas was eliminated by the action of the first purifier in such a manner that the lime in the subsequent purifiers was converted, either wholly or to any extent that might be desired, into sulphide of calcium. It was said farther to relate to the use of washers or scrubbers, containing a solution of caustic soda, or of potash, or of ammonia, by the employment of which the carbonic acid was eliminated from the gas in such manner that, when the washers or scrubbers were placed before ordinary lime purifiers, the contents of those purifiers would be converted into sulphide of calcium, and thereafter employed in that form. When the washers or scrubbers were placed before purifying vessels containing sulphides of calcium, or sulphides of sodium, the contents of those vessels could be maintained in the form of sulphides. There were other matters mentioned in the specification, to which, for the present purpose, it was not necessary to advert more particularly. It was not disputed that, before the date of the letters patent, it was well known, to all persons acquainted with the manufacture of gas, that the vapor after quitting the washers or scrubbers contained carbonic acid, sulphuretted hydrogen, and other and different sulphur compounds, the nature and quality of which were not then, and perhaps were not now, so well known as to apply to them any specific means or characteristics. They had been called on various occasions by the witnesses, and in the course of the discussion, sulphides or bisulphides of carbon, or, generally, sulphur compounds without discrimination. Their existence or presence was, nevertheless, universally admitted. The sulphuretted hydrogen, that element in crude gas which was so peremptorily forbidden by the statute of 1868, it was known could be removed and neutralized by means of oxide of iron, and that process had been successfully adopted by the defendants. But oxide of iron had no effect upon the other sulphur compounds. Their existence and injurious effects were well known, and it was further known that lime, in the form of sulphide of calcium—in other words, lime—was a valuable agent for purifying gas from sulphur in other forms than sulphuretted hydrogen. It was known, both chemically and practically, that carbonic acid expelled salphuretted hydrogen, and this knowledge the defendants said they possessed before the date of the plaintiff's patent. Great care, and skill, and cost had been employed in the construction and completion of the defendant's works; frequent experiments had been made, and vigilant attention had been exercised by the defendants and their officers, who appeared to be well versed in the practical appliances of the manufacture, and not be deficient in mechanical and scientific knewledge, in endeavoring to purify the gas from the noxious presence of the sulphur compounds, but without any sufficiently successful results. The defendants had, in their answer, stated, with great distinctness and particularly, the modes in which they carried on the manufacture at Bow from the year 1867, and at Beckton October, 1870; the various alterations from time to time introduced, especially in the last-mentioned works; the results of the experiments they made, continuing the narrative up to May, 1872, and they stated the manner in which their works were at present conducted. From October, 1871, to May, 1872, the gas manufactured by the defendants had been tested and recorded, and returns made, and it appeared that during that period the amount of sulphur, other than sulphuretted hydrogen, varied from 45·2 to 27·70 grains, all exceeding the maximum, which had been fixed by the referees at 20 in 100 cubic feet. It was not upon their own scientific knowledge, and their abundant means of experiment, and their practical skill, that the defendants only relied in endeavoring to accomplish the great desirderatum in furnishing gas of such purity as the law required. They called in the assistance of chemists of well-known ability, being urged, as it would seem, to take this step in consequence of the repeated remonstrances from the secretary to the referees, founded on the returns, by which an excessive amount of impurity had been shown. In February, 1872, the defendants wrote to Dr. Odling and Dr. Letheby, informing them that the official returns had caused them much uneasiness, which was increased by the fact that all their efforts to make an alteration has so far been baffled, and requiring them to visit the works at Beckton to advise the defendants, should any means present itself to their minds by which they might secure a greater degree of purity than at that time appeared obtainable. Dr. Odling, in his reply, after expressing his readiness to help the company in the difficulty in which they were placed, observed to the secretary that he knew that the control of the amount of sulphur in gas was a matter upon which certain trustworthy knowledge was but very small. Both Dr. Odling and Dr. Letheby visited the defendant's works, and each made suggestions to the defendants with a view of remedying the evil then acknowledged and found to be existing, which up to that time the defendants hah expressed their inability to remove. The recommendations made by those gentlemen were in evidence. Dr. Letheby's examination of the process of manufacture and purification of gas was made, as he had recorded in his report to the secretary of the defendants, dated March 18, 1872, for the purpose of ascertaining the cause of the large excess of sulphur in the gas, and with the object of suggesting means by which the same might be obviated. He proceeded to recommend a better system of condensation, and prolonged contact of the gas with the products of combustion, the use of lime in the purifiers for a much longer time, whereby the sulphide of calcium or foul lime would act as an absorbent upon bisulphide of carbon, and would not afterwards be displaced by carbonic acid. He added that the aim and object of his suggestions were to effect the absorption of bisulphide of carbon by the alkalies of the sulphides of calcium and carbon, and also to permit the reaction of ammonia and bisulphide of carbon in the lime purifiers, so as to form sulphocyanide of calcium.

He was apparently acquainted with the actual condition of the works, and the machinery there in use. He did not, however, suggest any process by which his recommendations might be applied; but, in conclusion, he appealed to the large practical knowledge of Mr. Evans, the defendant's engineer, for bringing them to bear upon the question, so as to put them in

the best available form. Dr. Odling, in his report of the 28th of March, expressed the difficulty he felt on account of the very small amount of positive knowledge as to the condition under which crude gas became charged with sulphur; so as to the form or forms, of combination in which sulphur occurred in the gas; and as to the means by which it was capable of removal therefrom. He then laid down certain postulates, which merely expressed facts perfectly well known to all chemists, respecting the purification of gas from sulphur by means of sulphide of calcium, and recommended, first, the decarbonization of the gas by means of lime frequently renewed; and then transmitting the completely decarbonated gas through other lime but very seldom renewed; and finally, passing it through oxide of iron. He proceeded to recommend a process by which the decarbonization, which he considered so essential, should be effected, and pointed out that the lime in the purifiers, by its union with the remaining sulphuretted hydrogen and decarbonated gas, would quickly become converted into sulphide of calcium, capable of fixing bisulphide of carbon or sulphur compounds. He said, provided only the gas were constantly decarbonated before its admission, then there was no reason why the sulphide of calcium should not continue effective for months, or, at any rate for many weeks.

The use and value of these recommendations by the two gentlemen appeared conclusive, as to the evidence they afforded as to the degree of knowledge which was possessed upon the subject then under consideration. The chemical principles were well known.

It was a familiar thing to the company and its officers that lime would convert sulphuretted hydrogen into sulphide of calcium, and the sulphide of calcium being an alkali, would itself absorb, or neutralize, bisulphide of carbon which was acid in its nature. With this knowledge, and all appliances in their power and control, the defendants had toiled and tried in vain to reduce the sulphur in the gas within reasonable and lawful limits. The learned chemists who were consulted possessing all the same, and probably very much more, accurate knowledge, concluded that the decarbonization of the gas was the most important object to be effected, and recommended processes differing somewhat in mode, but aiming at the result by which the desideratum should be achieved. Those recommendations were made after the date of the plaintiff's patent. If they had been before, and if the tentative processes which the chemists recommended had been adopted, and had succeeded, the object was accomplished. The means of reducing the sulphur impurities within lawful limits was obtained. Nor could there be any doubt that such a discovery and improvement was a valuable one, which, at the same time that it dispelled and overcame the anxieties of the directors, furnished the public with a supply of reasonably pure gas, and would be a good ground for a patent, provided that the actual means of putting the principles they had recommended, into practical exercise and execution, had been described and resorted to. That, as it would seem, was the very invention which the plaintiff claimed to have made, when he said in his specification that it related to the purification of coal gas from sulphur by means of sulphide of calcium employed in separate purifiers, and to a principle and process of working lime purifiers whereby the carbonic acid was eliminated by the action of the first purifier in such manner as that the lime in the subsequent purifiers was converted either wholly, or to any extent that might be desired, into sulphide of calcium.

Dr. Letheby, in his recommendation, having pointed out defects in the manner of working the apparatus employed—namely, the over-working of the lime purifiers, keeping the lime for too long a time in the purifiers, the insufficient condensation of the gas which took place between its issue from the retorts and the commencement of its purification by washers and scrubbers, and the use of water in the last of the scrubbers, by which too much ammonia was removed before it passed into the lime purifiers, did not say or suggest that the first operation was to be on the carbonic acid, and nowhere suggested any addition to, or any alteration in, the apparatus then in use. On the contrary, he appealed to the practical knowledge of Mr. Evans to put the principles suggested by him into the best available form. In Dr. Odling's suggestion, the first and most important thing that he recommended was completely decarbonating the gas by means of lime frequently renewed, and then transmitting the completely decarbonated gas through other lime but very seldom renewed. It was admitted, and clearly established by the evidence, that the principle of Dr. Odling's recommendation was identical with that of the invention claimed by the plaintiff, and expressed in his specification. The manner of applying that principle was nowhere mentioned by Dr. Odling. He had examined, and was well acquainted with, the apparatus and mode and working employed by the defendants. It did not, perhaps, fall within his province to suggest any improvements in the mechanical contrivances by which the primary and essential condition which he prescribed, namely, the decarbonating of the gas before its purification, should be fulfilled. At all events, he did not so suggest, but said, if it could be contrived in any way to make the decarbonated gas remain in contact with the sulphide of calcium for a longer period, a better result might be anticipated.

That very contrivance was described in the plaintiff's specification. By that contrivance the decarbonated gas remained in contact with the sulphide of calcium for a longer period. That thereby a better result had been obtained was not a matter of dispute, for upon the pleadings it was apparent, and had been frequently admitted by the defendant's counsel, in the course of the argument, that the process was now used, employed, and practised by the defendants, in the manufacture of gas at Beckton, was identical with that which was claimed by the plaintiff as being his invention. The defendants denied, however, the novelty of the alleged invention, and disputed the validity of the patent upon several grounds, each of which, they said, was enough to establish the invalidity of the patent. Each objection had been argued at great length, and with consummate ability, and each was entitled to separate and serious consideration. Not the least important of them was the objection raised in the specification, which had been subjected, as it was right it should be, to a most minute and searching criticism. It was undoubtedly the law, and was perfectly just and reasonable, that a man who obtained a patent should be under the obligation of stating, in clear and intelligible terms, the nature of the invention he claimed, and the means by which that invention could be applied and practised. The construction of the specification, like the construction of all other written instruments, was in all cases for the court in which the question arose, and must be dealt with strictly, but also with a fair regard to the subject and the terms which were employed. The meaning of the plaintiff, whatever terms he employed, might be taken to be that he said to all the world, and addressing himself especially to persons engaged in the manufacture of gas, that he had found out a better mode of purifying gas than had been hitherto known and practised. The existence of impurities was notorious, the names by which they were called were known, the existing process of manufacture was known, and the failure to remove the impurities was known and acknowledged by all.

The plaintiff said he was the first person who had found out that there was a principle by which the object which others had been striving at for years in vain, could be attained; and he said he would tell the world by what process that principle could be applied.

Having regard to the subject with which the plaintiff was dealing, that meaning must, in all fairness, be ascribed to his specification. He did say, in very words, that he had been the first to see the importance of, and to practically carry into effect, the principle of excluding carbonic acid from lime purifiers, or from any required number of them, as a means of obtaining perfect results in the purification of gas from sulphur. The plaintiff said his invention related to the purification of coal gas from sulphur by means of sulphide of calcium, distinct from foul lime, employed in separate purifiers. That was the principle. He further said it related to a principle and process of working lime purifiers—things in use in all gas-works—whereby the carbonic acid in the gas was eliminated from the action of the first purifier or purifiers of the series, in such manner that the lime in the subsequent purifiers was converted either wholly or to any extent that might be desired, into sulphide of calcium. In subsequent parts of the specification he explained the manner in which he proposed to apply the process. He showed the most economical manner of making sulphide of calcium, and described what he called a new principle and process of employing lime purifiers. He described one process by which several purifiers might be employed in succession, or rotation, or he said the first purifier might be constantly employed. The claim, which was at the end of the specification, he said he considered novel and original; and, therefore, claimed—first, the employment of sulphides of calcium in separate purifiers, as a means of purifying gas from sulphur in other forms than sulphuretted hydrogen; secondly, a mode of employing lime purifiers in the manner described, whereby the contents of all the purifiers would be converted into sulphides of calcium, and also, if required, be maintained in that condition. It had been argued for the defendants that, under the first head, the plaintiff claimed as a novelty the use of sulphide of calcium; whereas that substance, and its purifying effect upon gas, had been long known to chemists and gas manufacturers, and that the first process described being bad, on that ground the alternative process suggested by the plaintiff must be bad also; the law being, as it was truly said, that a patent granted for a claim which was bad in part must be held to be bad in the whole. But he did not think the plaintiff had, in any part of his specification, claimed the use of sulphide of calcium as his invention, or that the reference to the matter hereinbefore described vitiated or affected the claim in which those words were to be found. The objection of the defendants that the plaintiff's invention could not be the subject of a patent, did not appear to be well-founded. The plaintiff did not claim the discovery of a principle only, which would not be sufficient, but a principle combined with a process, easily applicable by any person acquainted with the manufacture of gas, by which the principle might be exercised for the purpose of producing the result indicated. The other objections to the specification appeared to be groundless, because the construction of the instrument was reasonably clear, and there was no uncertainty or ambiguity in its expressions, nor did it contain any inconsistent claims; nor was it open to the objection that being bad in some respects, it must be held to be bad altogether. Then the defendants said there was no novelty in the invention, and to that point a very large proportion of the evidence adduced by the defendants had been directed. They had called the three principal officers employed at the defendant's works at Beckton and Bow, two very eminent professors of chemistry, and five other persons acquainted with the chemical properties of gas, the manner in which it was manufactured, and the means by which impurities were removed from it. They all asserted that there was no novelty in the plaintiff's invention, for that by the use of lime in the production of sulphide of calcium, and by its effect on the sulphur impurities, they might, and had been, in fact, removed.

All that might be perfectly true. If the plaintiff had denied it, and had founded his claim upon such denial, the evidence might have been conclusive against the patent. But not only did the plaintiff not deny the facts, but the invention adopted them. It was not satisfactory, although the practice was by no means new, to impart to an adversary something which he had neither said nor meant, and then pr

ceed, by demolishing it, to obtain an easy and certain victory. The plaintiff said that, if he granted all the defendants had said, they did not say that they knew the first essential process of removing the sulphur compounds from the gas was to eliminate carbonic acid by sulphide of calcium, not by foul lime, but by means of separate purifiers. No one of the defendant's witnesses had said he did; and until Dr. Odling pointed it out as a discovery of his, which probably it was, although made after the date of the patent, there was no trace in all the verbose and voluminous evidence which had been furnished by the defendants, that either the principle or the process described in the specification had been used or known in the manner, and for the purpose, described in the specification. If what the witnesses said were adopted, it was impossible to account for the excessive amount of impurity which the tables which were in evidence showed to have existed in the gas before the date of the patent, or for the frequent confessions of the defendant's agents that they did not know how to reduce that impurity, although they were earnestly endeavoring by experiment and otherwise, and although they had called in the advice of Dr. Letheby and Dr. Odling to assist them in effecting that most desirable object. Dr. Letheby's suggestions were different from the plaintiff's invention. Dr. Odling's were identical with them; but, until his letter was communicated to the defendants, there was no ground upon which it could be said that the principle and process patented by the plaintiff were not novel. That they had been proved to be useful was established by the fact that they had been adopted and used, and were now employed. The plaintiff had also gone into extensive evidence. Besides his own affidavit, which entered very minutely into the state of the defendants works, and pointed out what he alleged to be their imperfections and causes which occasioned the particular failure to reduce or control the impurities, he referred to the table of returns by which those deficiencies were shown, and which was also in evidence. Upon many points his statements were corroborated by Mr. Pearce, one of his co-referees. Two professors of chemistry stated, without qualification, that the plaintiff's invention was new and useful, and they gave reasons upon which their opinion was founded. Six other witnesses, described as persons conversant with the manufacture of gas before the date of the patent, gave similar testimony, and deposed to the facts from which their knowledge was derived and their conclusions formed. If the case depended upon the allegations of the witnesses on both sides, the conflict between them was so great that it would be difficult, if not impossible, to arrive at a satisfactory determination. But, for the reasons which presented themselves to his mind, the questions in the case might be determined without resorting to the oral evidence alone, although it was by no means to be disregarded nor had he neglected to consider it with the utmost attention. Another ground upon which the novelty of the patent was impeached was that a patent, which was taken out by William Mann, had anticipated the plaintiff's alleged invention. The provisional specification by Mann, filed on the 2d of December, 1871, after stating the principal impurities, and the means by which several of them could be removed, said the sulphur compounds, other than sulphuretted hydrogen, had baffled all attempts to remove them completely with any degree of certainty. He then proceeded to describe a process, consisting of several purifiers charged with hydrate of lime, through one of which gas was allowed to pass, sufficient to convert its contents into sulphide of calcium. The crude gas was then shut off from the vessel before mentioned, and made to pass through another, by which it was freed from much of its sulphuretted hydrogen; it hen passed up to the oxide of iron purifier, where it was purified from sulphuretted hydrogen, and fitted for entrance into the sulphide of calcium purifier. Then he said further it was presumed that the gas, having passed through hydrate of lime and oxide of ron, had been completely cleared from all impurities xcept bisulphide of carbon, and it was then free to be acted upon by the sulphide, or the sulphides of calcium, with which it would combine. The fuller specification, filed by Mann on the 1st of June, 1872, went into greater details as to the processes employed, and concluded by claiming as his invention the use of sulphide or sulphides of calcium, formed and used in the order and manner there described. The order and manner there described were not only not the same as those mentioned by the plaintiff, but were, in fact, the reverse. Freeing the gas from carbonic acid was mentioned, but it was said to be effected by exposure to lime or oxide of iron; and instead of being the first process, as described by the plaintiff, and proved by Dr. Odling to be a process effectual, and not before employed, it was not until after the gas had been dealt with by the other purifiers that the vessel described by Mann was to be brought into action, for the purpose of purifying the gas from sulphur compounds. Neither did Mann's specification point out the manner in which the sulphide of calcium was to be generated, or as long as might be requisite. It would be enough to say that the specification of Mann, anterior to that of the plaintiff, could not invalidate the plaintiff's patent, inasmuch as it did not disclose a practicable mode of producing the effect which the plaintiff described. *Betts v. Menzies*, in the House of Lords, was a very distinct authority on that point. Besides, Mann's patent had never been brought into actual operation, but had been suffered to drop, and was no longer in existence. The defendants insisted, moreover, that the invention claimed by the plaintiff had been used by them before the date of the patent; and to this end a considerable portion of their evidence and arguments founded upon it had been addressed. They proved the manner in which the manufacture at Bow was, for several years before the patent, conducted by Mr. Harris, who employed, and still employs, two purifiers to take out the carbonic acid —a fact which, however clearly established, did not touch the plaintiff's invention; for although Mr. Harris's purifiers might have the effect of taking out the carbonic acid by means of lime, that was not the only office they performed, but were part of a general system of purification. He did not say they were employed for the purpose of eliminating carbonic acid in the first place; and with what success they were employed before March, 1872, at Bow, was shown conclusively by the tables, from which it appeared that the average impurity at Bow, though probably below that at Beckton, in March was 22·8 grains, which was beyond the maximum; whilst, from causes which the defendants did not attempt to explain, it fell in the next month to 12·5. The defendants had endeavored to account for the excessive impurity at Beckton by several reasons. They said the condensers were imperfect, that the temperature of the gas was too high, that the purifiers became distorted, and several other things of a like kind. However that might have been, the excessive impurity continued, and they were unable to reduce it or check it, in spite of all their earnest endeavors, until after the date of the letters patent, or until they had received Dr. Odling's suggestion, which, although made after, was beyond doubt identical with the plaintiff's. Mr. Trewby had stated the experiments he made at various times, which, it was insisted, were an anticipation of the plaintiff's invention. That those, whatever they were, had not been successful, was not disputed. If they had been, the cry of distress which ran through the correspondence would not have been uttered by them. He gave an account, in his letters, of numerous experiments which had been made, and their failure; and, in a letter of the 19th of February, he attributed the increase in the bisulphide of carbon to the coals which had been in use, whereby, he said, the sulphide of calcium was no sooner formed, and in a state to take up bisulphide, than the carbonic acid took its place. In the same letter, after stating that within the last few days he had been working the purifiers in a somewhat different form—that he had kept certain purifiers for the purpose of taking out carbonic acid only, and the remainder for the sulphur —he said he was in hopes that would do good. If these repeated experiments had been successful, Dr. Letheby's advice might have been spared, and when Dr. Odling showed Mr. Trewby how to proceed successfully, the reply would have been that he knew it all, and had done it all. On the contrary, on the 21st of March, Mr. Trewby was acting on Dr. Letheby's suggestions, and certainly with a beneficial result, obtained, however, at a most alarming cost. And on the 22d of March, Mr. Trewby wrote to Dr. Letheby saying that his earlier experiments and results were not what he could have wished. He mentioned a new plan which he had adopted in February, which was in operation at the time of Dr. Letheby's visit, whereby he got down to 29 grains, since which he had reduced it to 20, and he said that at that time they had about 42 grains, which they reduced one-half in the way they were working, and he was in hopes that as they extended the system of purification, they would be able to reduce it still more. It might be that Mr. Trewby knew the presence of carbonic acid was the obstacle. Indeed, it was clear he was making experiments to overcome it, and that he had partially succeeded. But even if it were assumed, which, as a matter of fact could not be done, that he had conceived the same idea as the plaintiff, it would amount at the most to this, that two men travelling on the same road in search of the same object, the one who first obtained and described it in an intelligible and accurate expression, and who obtained a patent for the protection of what he had thus acquired, could not be deprived of it because another had tried to reach the gaol before him, but did not. Then it had been said that the plaintiff's invention had been published by means of a letter which the plaintiff wrote to Mr. Trewby before the date of the patent, the purport of which was that he requested Mr. Trewby to try certain experiments respecting carbonic acid. It was written at a time when the plaintiff said he was getting materials for his specification, which he shortly afterwards filed, and because he wished to have the experiment he suggested, tried upon a large scale, which the Beckton works afforded. Without ascribing to the letter the character of a confidential communication, it was no publication. Mr. Trewby, who did not return any answer to the letter, thought so too, for he denied emphatically that he received from the plaintiff any information which guided him in the experiments which he made, or in the discoveries which were arrived at. It had been suggested, also, in the course of the argument, that the patent was invalid in respect of the 3d, 4th, and 5th heads of the invention. Those objections could not be said to have been put fairly or sufficiently in issue by the defendants, or that any evidence had been adduced upon which they could be sustained. All the defendants said in their answer was, that they had never tried the process purporting to be described in those three heads, and had no intention of doing so, that they believed there was no novelty in any of them, and that such process had no practical value whatever in the purification of gas from sulphur, or for any other purpose.

In Mr. Evan's affidavit, he said such processes were all well-known to gas engineers, and used in the purification of gas. The statute, 15 and 16th Victoria, provided that, in actions at law, no evidence should be admitted unless the objection had been distinctly raised, and the principle of that enactment had been recognized and acted upon in courts of Equity. The plaintiff having stated in his specification the object he proposed to attain—viz., the purification of gas from sulphur compounds by means of sulphur in a fine state of division used along with sawdust, or such like substance—said, in his 5th head, he claimed the employment of sulphur in a fine state of division, with an inert substance. Upon that it had been argued that where oxide of iron had been employed to take out sulphuretted hydrogen, some portion of the sulphur must, in that process, have been deposited on the iron, and that upon its being revivified, the sulphur so deposited would form sulphur in a fine state of division, with an inert substance. He could not, however, think that in a just mode of considering the

specification, oxide of iron, which was a most active and efficient agent for taking out sulphuretted hydrogen from the whole volume of gas to which it was exposed, could be said to be one of those inert substances, like sawdust, which the plaintiff proposed to employ with sulphur in a fine state of division. The only other objection to the plaintiff's suit was directed against him personally. The answer alleged that the plaintiff, previous to his appointment as gas referee, had no acquaintance with the business processes of manufacturing and purifying gas, and the defendants believed that the plaintiff derived his knowledge of the methods which he pretended to have invented, from opportunities afforded him in his official position, of seeing the processes employed by the company, and from information directly supplied to him by persons employed by the company. The defendants submitted to the court whether it was competent to the plaintiff to make use of the knowledge acquired by him, as a public officer in the discharge of his duties, for the purpose of taking out a patent. That objection had been earnestly enforced in the course of the argument.

He could not say that he thought the plaintiff was disqualified, by reason of his employment, from availing himself of any discovery which he might have made. His duties as a public officer were very clearly prescribed by the statute under which he was appointed, and he appeared to have discharged those duties, in co operation with the other referees, efficiently, and certainly without any censure or complaint that had been heard of. No doubt he could not have made the discovery he had, unless he had obtained extensive knowledge of the manufacture and purification of gas. How much of that knowledge was derived from information afforded to him by the company's officers, and how much of it was the result of his own inspection and observation, need not be inquired into. But whatever was the extent of the information, it did not seem to have been more than his powers under the statute would reasonably entitle him to acquire, nor to have led to the discovery in any other manner than knowledge of known laws and principles must exist before an invention can have an object to which it could be applied. He had not thought it necessary to go into the report of the referees made on the 27th of March to the Board of Trade, because he did not think it affected the real question between the parties. Many authorities had been referred to on both sides; but as the law upon the subject was perfectly familiar, and open to no doubt, it was needless to mention them. If the objections taken by the defendants were well-founded, then it was clear that the patent could not be sustained. On the other hand, if these objections failed, the plaintiff's rights were established by numerous decisions. He had now gone through the principal and only important topics which had been discussed. He had attended to the discussion during many days, and had since looked through the evidence, and considered the arguments which had been addressed to him. The task had been somewhat laborious; but, having performed it as well as he was able, he came to the conclusion that the plaintiff was the inventor of the principle and process by which the purification of gas from what was called the sulphur compounds might be effected to a greater extent than had ever been practically done before the date of the letters patent; that the defendants had adopted, and were now practising, that invention; that they had been, and were able to keep down the amount of impurities in gas to an extent and degree very far superior to that which existed before the date of the plaintiff's patent rights were created. They were also able to exercise a much greater control over those impurities than they had been able to do previously. The defendants thus having practised the invention without the plaintiff's consent, he was entitled to the injunction prayed for by his bill, and he was also entitled to be paid by the defendants such damages as he had sustained by their unlawful use of that which was his exclusive property, and for that purpose an inquiry must be directed to ascertain the amount of such damages.

Mr. Kay: With costs, of course?

The Vice-Chancellor: Yes.

Upon the application of Mr. Davey, for the defendants, the injunction was suspended for three months the defendants undertaking to abide by any order the court might make as to damages in consequence of such suspension. Mr. Davey stated that the defendants might desire to take the opinion of the Court of Appeal; and if they did not do so, they would have to decide whether they should arrange with the plaintiff, or effect an alteration in their works, which could not be done under some considerable time. He undertook, in case they decided on the first-mentioned course, to present a petition of appeal forthwith.

On the application of Mr. Aston, the Vice-Chancellor said he would grant a certificate under the Act, that the validity of the patent had come in question.

Our reporter omitted to state that the solicitors for the company are Messrs. Curtis and Bedford, of Haberdashers Hall, Gresham Street, London.

The Delta of the Mississippi Valley, Considered in Relation to an "Open Mouth River."*

BY JOHN G. BARNARD, U. S. CORPS ENG.

Transactions of the American Society of Civil Engineers.

To furnish an outlet to the Mississippi which should evade the bar obstructions of the mouths, a "ship-canal" had been proposed, first in 1832, by Mr. Benjamin Buisson, State Surveyor; and again, in 1838, by Maj. W. H. Chase, U. S. Engineers; and the project was referred to by the Board of 1852, as one to "fall back on" in case of failure of all efforts to procure an open mouth; thus placing it in its rightful category of a *dernier resort*. This project was revived

"*Resolved*, That the Secretary of War be, and is hereby requested to cause an examination and survey, with plans and estimates of cost, to be made by an officer of Engineers, for a ship-canal to connect the Mississippi River with the Gulf of Mexico, or the navigable waters thereof, of suitable locations and dimensions for military, naval and commercial purposes, and that he report upon the feasibility of the same to the House of Representatives."

In the summer of 1873, a Board of Engineers of which the writer was President, was convened "to consider and report upon" a plan which had been in the meantime prepared in fulfillment of the above. The question submitted to the Board was widened by the request of the Chief of Engineers, at the suggestion of the President, to consider "the expediency of improving the navigable outlet of the Mississippi, by the Fort Saint Philip Canal, as an alternative to, or a simultaneous measure, perhaps, with, the improvement of the passes."

The majority of that Board favored the construction of the canal and embodied their views as to jetties in the following paragraph:

"Upon a review of the practical difficulties which the adoption of the jetty system of improvement at the mouth of the Mississippi would entail, and a due consideration of the original cost of construction and of annual extension, entertaining doubts, moreover, of the successful issue of the attempt, the Board do not consider it advisable to recommend it."

The single dissenting member took the ground "that before resorting to an artificial work of the difficult and costly character of a ship canal, a more attentive consideration of the superior advantages of the natural mouths, and of the fair probabilities of utilizing them, is needed."

And again; "the advantages of an open river mouth are inestimable. The needs of a navigation so great as that which now exists, and which in the future of the great Mississippi Valley must be fifty fold increased, demand it."

"It is said that the 'time has come' when the needs of commerce demand the canal; but I answer that the *time will come* when there will be the same cry for navigation unimpeded by locks—an *open river mouth*—which we now hear for a canal."

The argument, as put in this last quotation, contains the very pith of the question. No seaport in the world would substitute a ship-canal, with locks, for an open sea entrance, if the latter be not *unattainable*.

Would New York, for example, accept as adequate a ship-canal, for her sole channel of access to the sea? And what limit shall be placed upon the magnitude of the freight-commerce which shall pour out of the great Mississippi Valley through its only outlet to the sea?

A ship-canal can be but a make-shift, a *pis aller*, only to be accepted on *proof* that there is *no reasonable hope* of an "open mouth." How shall that reasonable hope be established save by reference to what *has been done* elsewhere, and by an appeal, not to theories—for theories simply mock the subject by their impotence to grasp the complicated conditions—but to such simple elementary *facts* as may guide our estimate of probabilities? Here all the burden of proof is thrown on the opposer.

To say, in face of the highest authorities* on this subject, in face of *achieved success* in numerous instances, that there *are no probabilities*, or that there are none which justify an attempt which has for its end a result so indispensable to a great navigation, require not merely transcendent engineering abilities—it requires something like *prescience*.

The question is *not*, therefore, purely an engineering one. To fail (if the contingency of failure be admitted) is far from being an *engineering* failure: for the undertaking is not merely justified, but *demanded*; unless, indeed, the engineer can deny even the *possibility* of success.

While no engineer, it is presumed, would trust his prescience so far as to deny *possibility* of obtaining by jetties an "open river month," there are a few simple arguments on which to assert—*first*, the strong probability of success; *second*, that the *maintenance* of the accomplished open mouth need not be regarded as involving an unreasonable expenditure or an excessive amount of work.

As to the *first point*; no one, whether "engineer" or otherwise, has yet denied the certainty of *obtaining* by jetties the desired result.

Hence the *second point* only, requires to be dwelt upon. In the draft of a minority report, dated New Orleans, December 6th, 1873, this matter is thus set forth:

"Now as to the application of this work. For reasons which will appear hereafter, I should select Pass à Loutre for experiment. A glance at the chart will show that from the point in the Pass where the depth of 25 feet ceases to obtain, to the *outer crest of the bar*, is about 2½ miles (at the South West Pass over 4 miles). The natural width of the Pass where 25 feet depth obtains is about ½ mile). * * * * By stopping the North Pass, and extending parallel, or nearly so,† jetties which, starting at the cessation of 25 feet depth (above the North Pass), extend, a half mile apart, 4 miles to points opposite the outer crest of the bar must be excavated to 25 feet (*i. e.*, the 25 feet channel will be extended at once 2½ miles): the velocity of current maintained unimpaired up to this point will carry its sediment far beyond, into deep water. The present regime of a shoal bar cannot again be restored, until the vast bottom area now covered with deep water beyond, for a distance of 2½ miles, is raised. That there will be a 25 feet, or even a 20 feet available channel *all* this long time I do not contend, but this I do contend, viz.: * * * that once extended out to the crest of the existing bar, jetties do not require the incessant *following up* sup-

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* Abstract of a paper presented to the American Society of Civil Engineers.

by the following resolution of Congress, passed 14th of March, 1871:

* In Europe, *e. g.*, we have Sir Charles Hartley, engineer of the successful jetty construction of the Sulina; Col. James Stokes, Royal Engineers, British Commissioner for same work; and Mr. P. Caland engineer of the works at the mouth of the Meas; all advocating an 'open mouth" for the Mississippi; nor can the opinions of these eminent engineers be impugned by the allegation that, being foreigners, they are unacquainted with the physical peculiarities of the Mississippi. They have all studied it attentively with access to the most authoritative information; including the work, the "Physics and Hydraulics of the Mississippi."

† Perfect parrallelism is not necessary; large deviations may be made to select the best location.

posed; that they may *ultimately* require extension I do not dispute."

The recent Board of Engineers (of 1874), to which the whole subject was recommitted, used, in giving its decision in favor of jetties, substantially, but quite independently, the same argument, though more fully and clearly developed.

"At present, the muddy water issuing from the South Pass spreads out in somewhat of a fan-shape, the handle of the fan being at the mouth of the pass and the ribs several miles in length."

"If the proposed jetties were instantly completed, and the new channel scoured out, essentially the same amount of sediment would be spread out in fan-shape, but, from the greater velocity of the issuing water, the ribs of the fan would be longer, while the handle would be narrower. More of the sediment would at first be deposited far out in the Gulf than before.

"But with the present rate of advance, the 25 feet curve 120 years ago was about 12,000 feet above its present position; and if the volume of water carried by the pass is kept the same, neglecting the slight difference in slope of the Gulf bottom outside the present bar, in about 120 years a new end for the pass will probably be formed of the same general shape as the lower 12,000 feet of the present pass. It makes little difference, in the whole time required to accomplish the work, whether the same volume of water flows out at starting over the present shallow bar or from beneath two dikes which force the water to take a depth of 30 feet. In an average of many years, the rate of progress must be about the same as now, namely 100 feet per annum, the volume of water being kept as at present; and it is on this basis that the average annual cost of extension, namely, $130,000, has been computed.

"It has already been stated that it is proposed to obtain a depth of 30 ft. between the jetties, in order that some years may elapse before the shoal which will form beyond the jetties can have on it less than the required depth of 25 feet in the channel through it. There are no precise data for estimating this period. Going seaward from the upper end of the proposed dikes, the slope of the bottom of the South Pass is about 1-440. This slope doubtless depends mainly on the velocity of the water flowing through it and on the lifting of the fresh water by the salt. As the causes remain essentially the same, it would seem natural that the new end of the South Pass to be formed by the sediment passing through the jetties should at least have the same bottom slope. If this assumption were true, the bottom would at least shoal from 30 to 25 feet in a distance of $5 \times 440 = 2{,}200$ feet, and the time required would be about twenty-two years."

Mr. Eads in his pamphlet entitled "The Jetty System Explained" (printed in 1874), pages 6-7, dwells on and develops the same principle, justly reasoning from the facts of nature, that between the lowest point at which there is 60 feet depth in the South West Pass (whether that *final* 60 feet be in the unmodified pass, or suddenly realized, by means of jetties, on the site of the *present* bar) and a bar having only 15 feet, there must be a distance of 7½ miles –and the *time* for the creation of a new bar (if by jetties the present bar be deepened to 60 feet) must be equal to the number of feet in 7½ miles divided by the amount in feet of the *present annual* advance; a quotient which he assumes to be 178 years.

The arguments are *essentially* identical in all the three independently exhibited forms. These reasons are in themselves the broad and indisputable *facts* of observed configuration. All that has, in a different and conflicting sense, been arrayed is–where not pure assumption—based on theories* which have themselves, no sufficient inductive basis.

But the matter may be somewhat otherwise stated, thus—the passes can prolong themselves no faster than they can build up their base of formation; the broad *bank* on which their bed is laid and that serves as the solid *trough* (as it may be called) which conveys them to the sea. The *front* on which this fan-like expansion over which the great delta arms are laid, has an extent measured on the 100 feet (depth) curve of about 40 miles. The material if all laid *within* (and we know it is transported far beyond) the 100 feet line, cannot advance this front much more than 300 feet per annum. Or if we take the South West Pass by itself (forming a kind of salient on the western extreme of the general configuration) its base measured at the same depth is 10 miles (even on the 18 feet curve the base is 5 miles), and this same configuration obtains whether we refer to Talcott's chart of 1838 or the Coast Survey chart of 1867, during which interval there has been a *general* progression of 1½ miles. The side banks, from the pass to lateral deep water, are quite pertinently compared by Mr. Eads to completed natural jetties; and as such they must complete themselves as they advance. There is every reason to affirm that the advance, whether the material be projected with high velocity over a bar crest 2,000 feet long, or with low velocity over one 11,500 feet long, cannot be made on a base of *less width than we observe to be essential to the natural advance.**

Stress is laid on this exhibition of the case because it discards all theorization, and all subsidiary and disputable questions of "littoral currents," "tide," "wind," or "waves." If in the final minority report of the writer stress is mainly laid upon *precedent*, it is because successful precedent *is enough* to prove the claim that the "open mouth" should be striven for at the Mississippi; and because the greatest possible brevity was aimed at.

It will be noticed, doubtless, that in the passage quoted from the minority report as first drafted, preference is given to Pass a Loutre, not because the analogy between the South Pass of the Mississippi and the "Sulina" (both bearing about 8 per cent. only, of the total discharge) had not already attracted the attention of the writer; but because in sketching out, under great pressure as to time, some outline of an application of the jetty system to the Mississippi delta, it was deemed inexpedient to select an obscure pass—one which has never been known to navigation —for the purpose. Pass a Loutre is, on the other hand, in some degree a rival of the South West Pass, while the application there would involve very much less expense than to the latter. Preference was subsequently given to the South Pass for reasons fully set forth in the minorty report.†

In the foregoing, I have endeavored to give a concise history not only of actual operations at the delta mouths, but of the various projects for providing an adequate outlet, whether by operating on the mouths themselves, or by canalization. I have, at the same time, endeavored to make plain the grounds on which an "open river mouth" may be confidently hoped for.

In this matter the recent Board (of 1874), in all essential matters, is in unison with me. Its plans or its estimates are doubtless able and thorough, and in absence of any precedent for the kind of work it proposes, are naturally founded on the best foreign precedents, which are those furnished by the practice of Holland, and more especially by recent works at the mouth of the Maas.‡ These works were visited by me in 1871, and fully described with full details of the facine and ballast construction ("zinc stukken, &c.) in Professional Papers, Corps of Engineers, No. 22, and the methods indicated as likely to "prove especially available in Louisiana." But at the same time they can but serve as *models*. In practice and adaptation to the peculiar locality, I believe they may be much simplified and the desired results of the jetty application be arrived at more speedily and economically than by following rigidly the Board's model.

In all that relates to the rival project of a canal, the recent Board has given incomparably the best solution of that problem yet offered. Nevertheless, while always admitting the *practicability* so far as the mere question of construction (a difficult one though it be), I am far from believing it to offer a reasonable assurance of success, if by *success* is meant the furnishing of an outlet at all adequate; I doubt much, whether in its *working*, it will fulfil even that degree of success which would be justified for similar canals in other localities, and I feel sure it could not be maintained for the small annual sum estimated.

Before closing this paper, I would advert to the case of the Rhone mouth, upon which much stress has been laid as an unsuccessful attempt to apply jetties. I have before me a copy of the "Raport sur les Projets presentés par les Ingénieurs chargés de la Navigation du Rhone."* made by a "Commission" of the "Ponts et Chausées."

Stating that the General Council (*Consei Gleneral*) of the Ponts et Chausées has already been engaged with this subject in connection with two projects presented by Mr. Surrell, it mentions the *first* as that for a "canal maritime," &c., &c., and the *second*, as one for *concentrating the waters of the Rhone in one single arm*, that of the "Grau de l'Est;" the council referred to, stating the principle upon which rested this project to be, "that the depth over the bar of a river mouth emptying into the sea is the greater, the greater the quantity of water which is discharged through it."

Thus we find it laid down authoritatively, at the very outset of this matter, not the *jetty* method but (see enumeration, page 107, made by the Board of 1852) a distinct and very different one, *i. e.*, that, specified in the words of the board just cited, as "closing the useless passes." And, indeed, through the forty closely written manuscript pages of the report before me, this, and this only, is dwelt upon and discussed in all its bearing, without even an allusion to the very distinct notion of jetties or, as more generally known in Europe, that of "parallel piers."

That the actual construction assumed somewhat the semblance (as far as they went) of "parallel piers," is due simply to the fact that it was deemed indispensable to connect the *dams*, which stopped the "useless passes," by dikes running over the low, intervening islands (*theys*)—that, on the east side it was found easier and more economical to make a continuous dike, riverwards of the islands, than isolated dams.

Finally, this Commission, concludes as follows: "Whereas," * * *

"3d. The delta arms (*graus*) of Piémanson and Rouston, which are the first derivations, up stream, from the main river, receive more than half the total discharge.

"4th. That the closing of these arms will constitute a valuable experience from which may be derived useful information.

"Therefore, the works to be executed for the improvement of the Rhone mouth should be confined to the closing of the Piémanson and Rouston arms."

The government, however, decided to carry out the plan of Mr. Surrell in full; and now let us hear in the language of Mr Malézieux (September 10th, 1871) *what* was done.

The works constructed constitute a continuous dike ("*endiguement*") upon the two banks of the Rhone, from the tower of St. Louis to the bar; that on the left has a total length ("*developpement*") of 7 kilometres (4½ miles), and stops at 1,531 *metres* (a mile less 80 yards), inside the crest of the bar; that on the right has a length of 6,500 metres (9-10 mile) inside the crest. * * * "The result of these works was to concentrate the waters of the Rhone in one arm," &c., &c.

And again, the official journal, "Annales des Ponts et Chausées" (1863, 2d semestre), refers to this matter in these words (translated): "After having at-

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*The two most prominent and sharply defined "theories" of bar formation are those of Mr. Ellett (the vertical *eddy* theory), and of the "Physics and Hydraulics of the Mississippi," pages 445-6, 7, 8, refuting the former and attributing the bar formation to the heavier sediments "pushed along the bottom," but which also calls for "vertical eddies", and a "dead angle, where the river water meets and rises upon the salt water." Were this latter theory *proven*, it would be far from sustaining the inverse rule-of-three computations of enormous bar *advance*, under influence of contraction by jetties, based on it in Ex. Doc. 290, page 31.

*The following from the "Physics and Hydraulics of the Mississippi," page 449, is but another *form* of the above affirmation: "The oscillating motion of waves, when meeting bottom, is changed into a motion of translation, and this tends to arrange the deposit made by the river *into the same gentle slope at which it disposes similar material at corresponding depths along the shores.*"

†Ex. Doc. 290, page 124.

‡These, even in Holland, were the *first* applications of this kind of work to an *open sea exposure*. So successful has it proved that the lower legislative body of Holland reports that "*the complete success of the works at the Hook of Holland has removed all doubts as to the possibility of making piers at sea*" (*i. e.*, jetties) "*on our coast.*"

The construction, wholly of beton blocks at the sea entrance of the new North Sea Canal, has not proved so complete a success.

*Furnished to Gen. Wright, President of the Board of 1874 by M. Malezieux.

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THURSDAY, MARCH 17, 1876.

tempted to improve the mouth by concentrating all the waters in a single channel, the administration' (i. *e.*, of the Ponts et Chaussées) "renounced their fruitless efforts and had recourse to the construction of a maritime canal," &c.

It seems scarcely necessary to remark that the jetty system has never been applied to the Rhone mouths. The method of closing useless passes having resulted in failure, the work was abandoned without even an attempt to apply the true jetty system, and the alternative project of Mr. Surrell—a "canal maritime" (ship canal)—made. This, in the words of the report of the recent Board, "is more than adequate to the wants of commerce." Inasmuch as at that locality there are comparitively trifling wants to be supplied, in *our* sense of such needs, one might suspect a vein of irony in these words, when we consider what a "canal maritime" would be to the wants of commerce of the port of New York. Even those wants should not rival the exigencies of the now enormous, but yet undeveloped, freight-commerce of the Great West through its only outlet where the Father of Waters bears to the sea the spoils of half a continent!

The Position of Dry Gas Meters is said by a writer in *Chambers's Journal* to be of no importance, but it is regarded as important that wet meters should be "below the level of pipes carrying gas to the burners, and in a moderately cool place; for, if too warm, a vapor will arise from the meter and ascend in the pipes, causing jumping lights, which all have observed." Of course it is important also that the wet meter should be placed where it will not be liable to freeze in winter. It is not important, so far as the continuous working of a dry meter is concerned, whether it be placed in a cool or a warm situation. So far as its measurement of gas is concerned, it will, however, if placed in a warm location, measure against the consumer. We should certainly regard it as important, if we had to purchase air by the quart or gallon, that the air so purchased should not be expanded by heat; yet we have seen dry gas-meters placed in very close contiguity to a set of steam-radiating pipes, the heating-power of which was such that the gas passing through the meter could scarcely have been delivered in the service-pipes of the building at a less temperature than 100 Fahrenheit. Very limited arithmetical skill will enable any of our readers to determine, with the aid of a table giving the expansibility of gases under different temperatures, the relative values of a cubic foot of illuminating gas passing through a meter at a temperature of 60 and another at a temperature of 100.

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—ED.

The Lowe Gas Process.

87 ASTOR HOUSE, March 10, 1876.

Mr. Editor: The managers of the Lowe process have of late been charged by gas men, with *undue modesty*, and lest this amiable virtue should degenerate at their hands, I make haste to offer explanation.

Doubtless the charge is traceable to the fact that three years ago they received a naked theory from its inventor, which, despite the gloomy prediction of many that it would die, they pledged themselves to nurse and develop, and that since then they have been too fully occupied in an honest fulfillment of that promise, to spend much time in trumpet blowing. From the start it has been a cardinal principle with them to push the process, and rely upon its practical operations for success. They have contributed their own time and no other man's money to demonstrate the merits of the system. They have solicited as respectfully as they know how, the critical investigation of the best engineers, courting the extremest tests, and when these have been repeatedly applied and successfully met, have demanded no committal of opinion from the visitor.

Some gentlemen who stand exceptionally high in the profession, have been so kind as to make frank and emphatic acknowledgement of the success of the process, while others have returned home with convictions apparently too deep for utterance, as we have heard no more of them. If their silence is because of an unwillingness to express adverse opinions, we beg them to dismiss such modesty. We have supposed that any parties who were working with good degree of success, to solve the problem of making better and cheaper light, were entitled to rank as friends, but we have not always been so treated. Nevertheless, we have aimed to pursue our business persistently and with courtesy. We have now, however, reached a point where, having paid out a good deal to acquire a practical knowledge of gas making, we feel justified in resenting any intimation that we do not understand whereof we speak, and make so bold as to lay down the following proposition to the gas companies of the United States, viz.:

That, by no process to this present time known, and demonstrated on a large working scale, has an illuminating gas of so fine a quality, been produced at anything like so low a cost, as by the Lowe process. We are ready for questions and for a show of facts, for we prove our "faith by our works."

Yours very respectfully,
G. S. DWIGHT.

Letter from Magnus Ohren.

CRYSTAL PALACE DISTRICT GAS CO,,
LOWER SYDENHAM, S. E., LONDON, Feb. 15, 1875.

Mr. Editor: In your Journal of Jan. 3rd, I find a letter from Mr. Smedberg, acknowledging the receipt of some details from me, and describing me as Engineer of the Company. He also adds my name to the figures and puts "Eng'r" after it, as if it had been so signed by me. I beg to say I did *not* so sign it. I am the *Secretary* of the Company so named, and the Engineer is Mr. James Watson; to that gentleman alone must be given the credit of these workings, and I beg that you will insert this letter to give him his just due.

Mr. S. asked his American friends to give him information on those points. I sent him one of my pamphlets on Gas Cooking Stoves, and, thinking it would interest him, I gave him the workings of this company to compare with others in America. He has evidently mistaken my description. The memorandum was not sent for publication, but as it is published I must beg of you to have the error corrected.

Yours respectfully,
MAGNUS OHREN.

Gas Enricher.

PITTSBURGH, PA., March 10, 1875.

Mr. Editor: In our February circular we reproduced a portion of an article by Mr. John McClarty of West Pittsburgh Gas Works, on petroleum as an enricher. We were not then aware that a patent covered the process referred to, and without any intention to mislead any one, stated that no patent covered Mr. McClarty's process. In justice to Mr. McClarty, we wish to state through your Journal, that the process is covered by patent of June 29, 1875. By giving this note space in your next issue, you will much oblige

Yours respectfully,
PAINE, ABLETT & TRIPP,
Oil Refiners, Pittsburgh, Pa.

JOHNSTOWN, N. Y., March 7, 1876:

Mr. Editor: I would like to make enquiry through the GAS LIGHT JOURNAL, if there is any way of using up the gas tar, to advantage, which is made in a small works using four or five hundred tons of coal annually. Hoping to receive answers from some of the fraternity through your columns,

I remain respectfully,
SUBSCRIBER.

Gas-Light Intelligence.

United States.

PROCEEDINGS OF N. Y. BOARD OF ALDERMEN.—A communication was received from the Corporation Counsel in answer to a resolution of Alderman Bryan Reilly. The communication stated the Common Council has no power to make ordinaces in relation to the gas companies.

The matter was laid over.

FIRE HYDRANTS.—Ald. Sauer offered a resolution directing the Commissioner of Public Works to cover the large water mains with large fire hydrants, to be placed on Broadway and other streets where necessary, so as to distribute water at higher levels. It was laid over.

When they tell us of how many gas meters are inaccurate, they forget to state how many are accurate.

The Bath, Maine, Gas-Light Company reduces the price of gas from $4·00 to $3.50 per thousand cubic feet.

The boring for gas on Boyd's Hill, near Pittsburg still continues night and day, at the rate of 40 feet every 24 hours.

The gas fuel experiment in the manufacture of flint glass, which has been in progress for some time past at Adams & Co.'s works on Tenth street, South Side, is likely to prove a complete success. The furnace has been heated to the highest standard, and the heating of the pots has been fully accomplished, and all that now remains is to melt the glass, which is being done. The last test in the whole experiment will be made on Monday next. John Adams, Esq., the senior member of the firm, and president of the Western Flint and Lime Glass Association, is giving the experiment his personal supervision.

PETROLEUM GAS IN GENEVA.—The experiment of making gas from crude petroleum in Geneva, N. Y., has been very successful. The light is brilliant and steady, and the price has been reduced to $2 85 a thousand feet.

SUFFOCATED BY GAS.—Providence, R. I., March 1.—Gas from a leaky main penetrated two houses on Wickenden street last night. Hugh Trainor, his wife and four children, in one house, were prostrated but have been restored to consciousness. The police effected an entrance to the other house and found Lawrence Lynch and his wife insensible in bed. They

have been partially restored and may recover. In another room of the same house Mary Josephs was found insensible on the floor and it is feared she can not be resuscitated. No gas was used in either of the houses.

Great Britain.

[From "Journal of Gas-Lighting."]

GLASGOW CORPORATION GAS-WORKS.—In the report sent to us last week, of the soiree given to the employees of these works, the Lord Provost was made to say that the quantity of gas supplied last year was 165 million cubic feet. The poor reporter, as usual, is blamed; he ought to have said 1650 million; but his mistake was nought.

FATAL GAS EPPLOSION AT LEEDS.—The coroner's inquest respecting the death of Mr. Levi Monk, who was killed by an explosion of gas at the Midland Railway Station, Leeds, on the 10th inst., was resumed on Wednesday last. After hearing evidence of persons on the spot at the time of the accident, the coroner adjourned the inquiry until the 8th prox.

GAS EXPLOSION AT WOLSTANTON.—A fatal explosion of gas occurred on Thursday morning last at the residence of Mr. Richard Edwards, Wolstanton. A servant girl went into a room, carrying a lighted candle in her hand. There had evidently been an escape of gas during the night, for her entrance was immediately followed by an explosion, which killed the unfortunate girl, and blew out the windows of the room.

LAUNCESTON GAS CO. LIMITED.—The first yearly meeting of this company was held on the 14th inst. Mr. J. Ching, chairman of directors, presiding. The accounts showed a profit of £609 on the year's working, or about 12½ per cent. on the capital subscribed. The directors, however, recommend a dividend of 5 per cent. only, carrying the remainder (£369) to a reserve fund, as a working capital, and to provide against any contingencies that may arise. It was resolved, on the motion of the chairman, seconded by Dr. Thompson, that the report and accounts be adopted, and a dividend of 5 per cent. was declared

MELTON MOWBRAY GAS COMPANY.—The half-yearly meeting was held on the 11th inst.—Mr. Fitton in the chair—when the accounts presented were considered to be satisfactory. The report from the engineer, Mr. Lomes, was of a very favorable character, and he stated that with the contemplated extension in the shape of purifying appliances, and the replacing of the retorts (which he thinks ought to be done next summer), the works will be in admirable state of efficiency. The directors report was adopted, and their recommendation of a dividend of 20s. for the half-year ending the 31st of December was unanimously passed. A vote of thanks to the chairman and directors concluded the business.

BROMSGROVE GAS CONSUMER'S COMPANY.—The report of the directors presented at the meeting of shareholders on the 14th inst., stated that the 2,000 additional shares of £1 each, raised a few months ago, had enabled the directors to pay off their mortgage debt of £800, renew a large portion of the principal mains, and enlarge the principal gasholder. Although the expenses had been extremely heavy, and a reduction had been made in the price of gas of 4d. per 1,000 feet, there was an available balance of £575 for dividend, which at the rate of 7½ per cent. was declared payable after the 1st prox.

CHATHAM & ROCHESTER GAS COMPANY.—The half-yearly meeting of shareholders was held on the 10th inst.—Mr. E. Winch in the chair. The report of the directors recommended a dividend at the rate of 10 per cent. per annum on the £50 shares, 7 per cent. each on the £12 10s. and £3. 6s. 8d. shares, and 10 per cent. on the £8 10s. shares. The Rev. F. J. Rawlins, Alderman E. R. Coles, Mr. E. Winch, and Mr. J. Levy were re-elected directors, and Mr. W. Homan, auditor. In the evening the directors and shareholders, with a few invited guests, including the Mayor and High Constable, sat down to a sumptuous dinner at the "Hotel," Rochester Bridge.

Chemical and Scientific Repertory.

We take the following items from the New York *Evening Post*:

The two planets, Nos. 158 and 159, discovered respectively by Herr V. Knorre on the 4th, and M. Paul Henry on the 26th of last January, have been named Koronis and Emillis. The latter was discovered so long after its opposition that it is extremely desirable to obtain more observations of it soon, for the calculation of its orbit before it passes out of view; but, the planet being very faint (below the twelfth magnitude), such observations can be made only with the aid of very powerful telescopes.

Griffith's enamel is a recent invention which is said to be unaffected by the action of carbolic acid, and hence useful for coating the inner walls of fever wards in hospitals. Plates of iron covered with this enamel, and exposed to the prolonged action of sea-water, are said to be kept fresh and clear from seaweed, the iron itself showing no signs of rust after the enamel is scraped off. It has been used by the British and other foreign governments. In India it is reported that it does not blister under the sun's heat. It has also been found effectual as a protection against white ants.

To make a copying ink which requires no press, take one ounce of coarsely broken extract of logwood, and one drachm of crystalized carbonate of soda; heat in a porcelain vessel with eight ounces of distilled water, until the solution is of a deep red color. Then remove from the fire and stir in one ounce of glycerine, fifteen grains of neutral chromate of potash dissolved in a little water, and a mucilaginous solution of two drachms of finely pulverized gum-arabic. This ink keeps well, and does not attack steel pens. The impression is taken on thin, moistened copying paper, at the back of which is placed a sheet of writing paper.

Lightning conductors are usually made of an iron rod, terminated by a point in platinum or gilt copper. Made in iron the point would oxidize rapidly and soon disappear, and in using two metals there is the disadvantage that contact between them is frequently defective. The lightning rod ought properly to be made of one homogeneous metal, without welding or solution of continuity. This requirement is met by a conductor invented by M. Saint-Edmé, which is made of a single rod of iron, in one piece from end to end, coated partly or entirely with nickel. The latter metal does not oxidize in damp air, it is a good conductor, and adheres closely to iron. The process of nickelizing is one easily and cheaply effected.

OLIVE OIL.—One of our city dailies remarks that it may not be generally known that a considerable quantity of California olive oil is finding an appreciative market here, and is coming into quite general use in our hotels and restaurants. Samples of the oil were recently submitted by a prominent restaurant keeper to a party of his patrons, who were good judges of the article, for an opinion. After critically testing it, they unanimously reported it to be a first-class article, and were much astonished on being informed that it was of California production. The article is put up by parties at Los Angeles in cans and cases, and is sold here at a slight reduction from the rates of imported oil. Owing to the prejudice against home products, the agents have been obliged to label it Plagniol, a well known French brand.

A correspondent of the *English Mechanic* gives the following directions for fixing pencil drawings: "Lay the drawing on a sloping board, and pour boiling water gently over it; this will remove all superfluous particles of lead, and will bring some of the size in the paper to the surface; boil some isinglass or gum-arabic in water to make a very thin size; pour it out on a flat dish to cool; run the drawing through the size, taking care that every part of it is well wetted; then lay it on a board to dry. The size should be so thin as to feel just a little sticky between the thumb and finger when cool. If too thick it will be seen on the drawing after it is dry. I have tried many ways of fixing drawings, but have never found any equal to this." Another writer says; "The best solution to fix drawings is that made with gum tragacanth. 1st. It sizes the paper. 2nd. It fixes the pencil drawing. 3rd. It does not chip when wetted. 4th. It enables you to continue the drawing afterward if desired; and 5th. It is possible to color over it."

Mr. William Crookes, F. R. S., has invented an apparatus for weighing a ray of light, which is thus described in the London *Times*: In a tube in which a vacuum has been produced, a very fine thread of glass is suspended by both ends and at one part of it is a small cross thread, to which is attached a disc of pith with one side blackened. At the junction of this cross piece is a small circular mirror so arranged that a ray thrown on it from a lime-light shall be reflected on to a graduated scale, and any twisting of the glass thread shall be thus recorded. At one end of the glass thread is a turning disc and a Harding's counter, outside the tube. The light to be weighed is allowed to fall on the pith. This, as in the simpler radiometers, is repelled, and its motion causes a torsion of the glass thread and a motion of the mirror spot along the scale. The turning disc is employed to unwind the thread against this action, the mirror spot going back to zero on the scale. The counter tells the degree of torsion the glass thread has undergone by counting the amount of unwinding required. Then a little iron weight, the one-hundredth of a grain, which is within the tube, is lifted by a magnet on to the little cross-bar, its weight causes a torsion, the mirror spot travels along the scale, and the unwinding is performed as before. A candle placed six inches away from the pith was found to give 1,628 degrees of revolution, and the little iron weight 10,021 degrees. The candle-light is therefore calculated to weight 0.00175 grains. Mr. Crooks has made experiments on the sun's light, and has worked out some calculations on it. It is equal to 32 grains on the square foot, 57 tons on the square mile, or three thousand million tons on the whole earth.

Rope Transmission in Mills.

Of late years the plan of transmitting power by endless ropes' instead of by flat belts or gearing, has been largely developed, and the results obtained have been such as to warrant the conclusion that the use of such means of transmission will become very greatly extended. In some cases failure, or excessive wear and tear, have resulted from the employment of inferior ropes, or of bad forms of groves to receive these ropes; but the system, when properly carried out, appears to give highly satisfactory results. Amongst those who have paid special attention to the carrying out of this system of transmission are Messers. Pearce Bros., of Dundee, Scotland, who now, we believe, invariably adopt it in their practice when the power of an engine has to be transmitted to a faster running shaft. The ropes generally used are 4¼ in., 5¼ in. and 6½ in. in circumference, and are made of thoroughly prepared hemp. For the transmission of small powers a single rope, of course, suffices; but for larger a number of ropes are employed side by side, each running in its own grove.

The system gives very great facilities for dividing the power of the engine between a number of shafts without the employment of vertical shafts and toothed gear, while the ropes also run very smoothly.

Messr. Pearce Brothers have, we believe, now applied rope gear to engines, developing in the aggregate about 7000 indicated horse-power, so that the system has been largely tested in their hands. Amongst other instances, they have applied such gear to a pair of engines for Calcutta, capable of indicating about a thousand horse-power.

In this country we have seen hemp ropes employed in several cases to good advantage in the transmission of power, and with good success. In cases where it is desirable to turn corners, or carry power to a considerable distance, the rope has advantages over leather belts. We call to mind one instance where two sharp angles had to be turned in taking power about 100 feet from one building to another; to have done this with a belt would, under the circumstances, have been very difficult, but with a rope it was almost nothing. It is somewhat more convenient to use hemp than steel or iron rope, as it will run with safety over smaller pulleys; it has the disadvantage, however, of having less strength, In small machine work round belts of leather have long been used to advantage, and the V shaped belt of leather, which has had such success in many situations, seems to be an approach to a rope. Although this method of transmission may seem to be primitive, and a return to the methods of our ancestors, we are inclined to think that it has advantages which will be found valuable in a great many instances.—*Iron.*

Kanawha Splint Coal is sold in this city for $13 a ton; that is at retail, in small lots for using in grates. It gives general satisfaction whenever it has been used. The trade could be wonderfully extended, if the price were put more nearly to the cost of putting it down here. It is gratifying to notice that in the face of all the troubles the Chesapeake and Ohio Railroad has undergone for the past two years, the shipments of coal via this line from the Kanawha region of West Virginia show an increase as compared with last season. There is an unlimited supply of coal of most excellent quality for gas, house or steam purposes, in the Kanawha region; there should be more of it used in the Northen States, and we trust the future management of the railroad will take an enlightened view of the matter, and endeavor to foster the coal trade.—*Coal Trade Journal.*

An Antwerp Chemist has lately discovered that the vapor of chloroform will not only extinguish the flames of petroleum vapor very speedily, but will even destroy its explosive and combustible proportions, if mixed with it. This discovery may prove capable of practical application in the prevention of fires.

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,

24 Pine Street, New York City.

March 16, 1876.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	Par.	Bid.	Asked.
Harlem	$1,850,000	50	120	123
Manhattan	4,000,000	50	270	275
Metropolitan	2,500,000	100	140	145
" Scrip	$1,000,000	..	101	—
" Bonds	500,000	1000	104	—
Mutual	5,000,000	100	109	110
" Bonds, gold.	900,000	1000	105	—
New York	4,000,000	100	145	148
Central, Westchester	466,000	50	100	105
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	180	—
Citizens	1,200,000	20	90	100
" Scrip	320,000	1000	99	—
Peoples	1,000,000	10	65	70
" Bonds	$ 325,000	...	—	95
" Scrip	300,000	...	85	—
Metropolitan	1,000,000	100	65	70
Nassau	1,000,000	25	—	101
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	122	—
" Scrip		...	96	100

Out of Town Gas Companies.

Buffalo Mutual, N. Y	750,000	100	—	80
" Bonds	200,000	1000	—	90
Baltimore, Md	2,000,000	100	170	...
" Ctfs., gold	1,000,000		100	—
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	90	—
" " Ctfs.	53,000	—	—	—
" " Bds.	124,000	—	—	—
Derby of Conn	160,000	100	...	80
East Boston, Mass.		25	132	—
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	41	—
Hempstead, L	40,000	100	...	—
Jersey City	386,000	20	160	170
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown, Maine	400,000	100	33	—
Lima, Ohio	60,000	100	85	...
" Bonds	30,000			
Laclede, Mo		100	110	115
Peoples, Jersey City		...	125	135
Peoples of Albany	650,000	100	31	—
" Bonds	350,000	1000	—	—
Peoples of Baltimore		25	96	...
Rochester, N. Y		100	50	60
Richmond Co., S. I.	300,000	...	—	—
Fort Wayne, Ind		100	...	—
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	

The following stocks were sold at auction—

275 shares of Metropolitan Gas Co., New York, @ 141 to 143½

Price of Gas.

New York, N. Y.	$2.50	
Manhattan, N. Y.	2.50	
Mutual, N. Y.	2.50	
Metropolitan, N. Y.	2.50	
Harlem, N. Y.	2.75	
Municipal, N. Y.	2.50	Water Gas.
Brooklyn, B'klyn.	2.75	
Citizens, B'klyn	2.75	
Peoples, B'klyn	2.75	
W'msburgh, B'klyn	2.75	
Nassau, B'klyn	2.75	
Metropolitan, B'k'n	2.75	
Rome, N. Y	3.60	
Syracuse, N. Y.	2.75	
Lyons, N. Y.	4.00	
Eastchester, N. Y.	3.50	
New Haven, Conn.	2.75	
Meriden, Conn.	3.93	
Lowell, Mass.	2.50	
Nantucket, Mass.	3.00	Meter rent 15 cts. p. m.
Belfast, Maine*.	4.00	
Wilkesbarre, Pa.†.	3.50	
Pittsburgh, Pa.	1.00	
Erie, Pa.	3.00	City lamps $28 p. an.
Hagerstown, Md.	3.75	
Charlottesville, Va.	3.50	Meter rent 20 cents.
Knoxville, Tenn.	3.00	Meter rent 15 cents.
Marietta, Ohio‡‡.	3.50	
Tiffin, Ohio.	3.00	
Elkhart, Ind.	3.50	
Guelph, Ontario.	3,50	
Brockville, Ontario	3.75	
Zanesville, Ohio.	2.70	
Citizens, P'keepsie	2.70	Gwynne Harris process
York, Pa.	3.20	
Jersey City, N. J.	2.75	
Albany, N. Y.	2.75	
Newark, N. J.	2.85	
East Newark, N. J.	4 00	
Bloomfield, N. J.	3.75	
Fredericksburg, Va	3.40	

* 10 per ct. off bills over $10; 5 per ct. off bills under $10.
† 10 per ct. off for prompt payment.
‡ 20 cts, per M. off if paid by 6th. Consumers over 3000 ft 30 cts. additional discount.

PRICES OF FOREIGN AND DOMESTIC GAS COALS.

[Reported Expressly for this Journal.]

March 2, 1876.

DELIVERED IN NEW YORK.

English Cannel.

Ince Hall	$17 00	@	18 00
Kirkless Hall	16 50	@	17 00

English Caking Coals.

Newcastle Gas	$5 50	@	00 00
Liverpool caking	11 50	@	12 00

British Province Coals.

Pictou			2 00
Block House—At Mines, $1.87, Gold			2 00
Caledonia—At Mines, $1.50, Gold			0 00
Little Glace Bay—At Mines, $1.75, Gold			0 00
Lingan—At Mines, $1.75, Gold			0 00
Sydney—Old Mine			3 00
" Reserve, $1.75, GoldMine			0 00
" International			— —

Duty, 75 cents per ton, gold. Freight to New York $2 00 currency. Cost of above coals delivered in New York, $4 75 @ $5 00, currency.)

Pennsylvania Coals.

Penn Gas Coal,—At Amooy	$5 60	@	0 00
Westmoreland—At Amboy	5 60	@	0 00
(In New York both the above coals $6 00)			
Shafton	6 50	@	0 00
Youghiogheny	6 00	@	0 00
Waverly	6 00	@	0 00

West Virginia Coals.

MurphyRun	$6 50	@	0 00
Despard	6 50	@	0 00
West Fairmont	6 50	@	0 00
American Gas Coal	7 40	@	0 00
Fairmont	6 50	@	0 00
Newburgh Orrel	6 50	@	0 00
Pinnickinick	6 50	@	0 00
Cloverhill of Virginia	6 00	@	6 50
McKenzie Compound Mixture			— —

American Cannel Coals.

Peytona of West Virginia	$12 50	@	00 00
Darlington of Pennsylvania			— —
Cannelton Cannel			11 00
Red Bank—at Philadelphia			6 50
" —at South Amboy			7 25

Asphalts.

Albertite of New Brunswick	$21 00	@	— 00
Trinidad Bitumen	— —	@	14 00

The Penn Gas Coal Company have contracted with the PittsburghGas-Light Co. for their entire supply for th ensuing year from their Youghiogheny mines.

Within the last week contracts have been made by some of the companies in New York for about 200,000 tons of Penn, Westmoreland, Waverly, Youghiogheny, and the West Virginia caking coals—at $6 00 per ton a reduction of 50 cents from last years' prices.

TO GAS COMPANIES, AND CITY GOVERNMENTS.

DYOTT'S PATENT CHAMPION STREET LAMP

Doubles the Light with the same quantity of Gas used in other Lanterns. *All others* waste half their light, illuminating the sky, or if the top s of metal, absorb it.

Single Top Glass Lamps both Globular and Square become heated if a good light is put in them, and rain, hail or snow falling upon the heated glass breaks it. When one glass is broken the wind will either blow the flame against the others and break them, or destroy the entire Lamp. *Nine-tenths of the breakage and cost of repairs of other* street lamps is owing to that cause.

Dyott's "CHAMPION" is the only double top—the only Lamp that has the Opaline White Dome, which is a *never changing reflector;* it doubles the power of, and throws the light to a greater distance. It is also a perfect *protector,* shielding the heated top or the lamp from all inclemency of the weather. The white dome is kept cool by the passage of air between it and the transparent globe below. Rain, hail or snow will never break either the globe or dome. The globe rests upon rubber cushions, and is supported laterally by elastic springs, so that contraction or expansion of the globe, or jarring of the post will not break it. They can be cleaned in one-fourth the time required to clean other lanterns. The metallic portions are of iron, copper and brass, and are the most durable, economical, efficient and cheapest lamps in existence. For public buildings, and wherever an ornamental and powerful light is required, they are made in clusters of 2, 3, 4, 6, 7 and 10 lamps, which have no equal in this or any other country for *beauty, durability, efficiency* and economy, either in cost, use or ornamentation. Designs furnished when requested for specific purposes. Gas companies, or those who have the lighting of Cities in charge, are solicited to communicate with us in reference to the agency for its introduction.

The Franklin Institute has awarded our Champion Lamp the highest premium: (they give a silver medal) and its Committee on Science and the Arts has recommended it as the best lamp in use. It has also invariably taken the highest premium at every Exhibition at which it has been presented, and elicits the strongest commendations wherever it is used. We have several new and handsome patterns of Posts for Corporations, Parks, public and private use, also for clusters of lamps, that are not excelled in beauty or price at which they are furnished. DYOTT MANUFACTURING CO.,
374-6meot 114 South 2nd Street, Phil'a, Pa.

Brooklyn Clay Retort AND FIRE-BRICK WORKS,

VAN DYKE STREET, BROOKLYN, N. J.

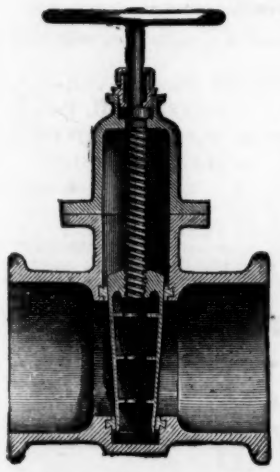
EDWARD D. WHITE, Surviving Partner of the late firm of J. K BRICK & CO. 402-1y

CHAPMAN VALVE MANUFACTURING CO.

MANUFACTURERS OF

CHAPMAN GAS VALVES.

Office and Sales Room 75 and 77 Kilby Street, Boston.

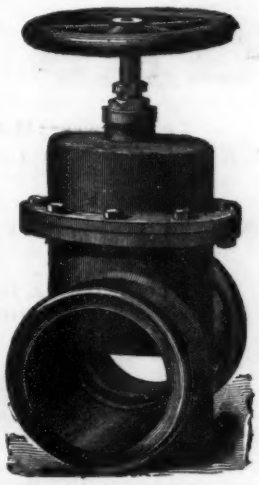


These Valves have been in use for several years, and are pronounced by all who have used them to be

The Best Gas Valves Ever Made.

They afford a direct passage the full size of the pipe. The seats are made of an alloy similar to BABBITT metal, specially prepared for the purpose, and superior to all other metals used for the seats of Gas Valves. It does not corrode under any circumstances to which it is exposed.

There is no LIABILITY OF COHESION between the Gate and Seat, and the Valves can be relied upon to SHUT TIGHT and OPEN EASILY at all times—an important desideratum when used for street mains, in cases of fire.



We refer to the following named Gas-Light Companies among the many that have used these Valves:

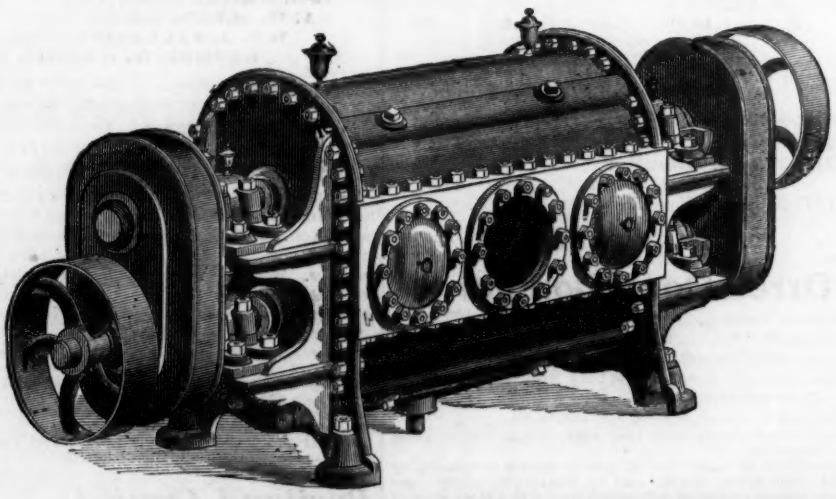
BOSTON GAS-LIGHT COMPANY, BOSTON, MASS.
CAMBRIDGE GAS-LIGHT COMPANY, CAMBRIDGE, MASS.
NEWTON & WATERTOWN GAS-LIGHT CO., WATERTOWN, MASS.
LAWRENCE GAS-LIGHT COMPANY, LAWRENCE, MASS.
PEOPLES GAS-LIGHT COMPANY, BROOKLYN, N. Y.
CITIZENS GAS-LIGHT COMPANY, BROOKLYN, N. Y.
SOUTH BOSTON GAS-LIGHT COMPANY, BOSTON, MASS.
CHARLESTOWN GAS-LIGHT CO., CHARLESTOWN, MASS.
LYNN GAS-LIGHT COMPANY, LYNN, MASS.
FITCHBURG GAS-LIGHT COMPANY, FITCHBURG, MASS.
CITIZENS GAS-LIGHT COMPANY, NEWARK, N. J.
WILLIAMSBURGH GAS-LIGHT CO., WIRLIAMSBURGH, N. Y.

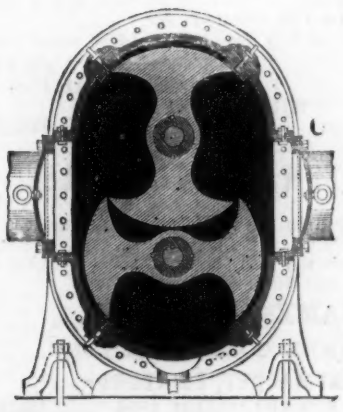
GAS AND WATER VALVES ½ INCH TO 36 INCHES DIAMETER.

STEAM VALVES ½ INCH TO 12 INCHES DIAMETER.

857-tf

PATENT IMPROVED GAS EXHAUSTER.





P. H. & F. M. ROOTS, PATENTEES AND MANUFACTURERS, CONNERSVILLE, IND.

S. S. TOWNSEND, GENERAL AGENT, 31 LIBERTY STREET, NEW YORK.

The following are some of the advantages we claim for this Exhauster over all others:

FIRST.—It is simpler in its mechanical construction than any other Exhauster in use.

SECOND.—The internal parts consist of only two revolvers, each cast entire in one piece, without a single screw, bolt, nut, washer, key or other part to get loose on the inside and stop or break the machine. The internal operating parts, therefore, can not get out order and hence require no care or attention.

THIRD.—Every part of the machine requiring care or attention, as the journals, gearing, etc., is external, easily observed and attended to. All changes, adjustments, and repairs are made from the outside. The journal bearings, if necessary, can be renewed in a few minutes.

FOURTH.—The internal operating parts are practically gas-tight, but are not in actual contact, hence there is no internal friction or wear. The machine is therefore operated with less power than any other.

FIFTH.—They are built in the most complete and substantial manner, with steel shafts and improved journal bearings, and their durability is almost without limit.

We build them of any required capacity, large or small, adapted to any kind of works or place.

Send for Illustrated Catalogue, giving all particulars as to capacity, speed, power required, dimensions, and price of each size and references to parties using them.

P. H. & F. M. ROOTS.

GAS COALS.

THE
PENN GAS COAL COMPANY

OFFER THEIR

COAL, CAREFULLY SCREENED,

AND PREPARED FOR

GAS PURPOSES.

Their Property is located in the Youghiogheny Coal Basin, near Irwin's and Penn Station, on the Pennsylvania Railroad, and on the Youghiogheny River.

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Greenwich Wharves, Delaware River.
366-1y **Pier No. 1 (Lower Side), South Amboy, N. J.**

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OF WEST VIRGINIA.

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CANNELTON CANNEL,

cknowledged to be the most valuable ENRICHER produced in this country, a gross ton yielding 10,000 ubic feet of GAS of 64·54 CANDLE POWER; COKE 32 bushels, of good quality.

CANNELTON CAKING COAL.

Volatile Matter.	Coke.	Per cent. of Ash in		Sulphur in			Specif. Gravity.	
		Coal.	Coke.	Coke.	Oötl.	Volatile Matter.	Coal.	Gas.
35.1	64.9	2	6	.82	1.48	.66	1.289	.476

MAXIMUM YIELD, 5.06 cubic feet of Gas per pound of Coal—A yield of 4·78 cubic feet per lb.—gave 16 14-100 Candle-Power.

COKE, of very fine quality—1453 pounds produced from one ton of coal.

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PERKINS & JOB, 27 South Street, N. Y.; 91 State Street, Boston.
H. W. BENEDICT & SON, New Haven.

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THE SUBSCRIBER IS PREPARED TO CONTRACT FOR the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES McKELVIE,

CANNEL COAL MERCHANT,

HAYMARKET, EDINBURGH.

ESTABLISHED 1840. 357-1y

WREN'S GAS WORKS.

W. C. WREN,

Corner of Jay and Water Streets,

BROOKLYN. N. Y.

HAVING GRANTED THE USE OF ONE OF my Patents to the Gas-Light Company of America, and settled my claim against them, I inform the profession that I continue to erect the Works known as

Wren's Gas Works,

and sell Licenses to use my Patents for making Gas from Petroleum.

Gentlemen of the profession:—As your consumers demand a better light, and as that demand has been in many cases sought in vain to be met by using different abortive imitations of my various processes, would it not be well to make success sure by trying the plan of the inventor.

You can enrich your Coal Gas to any desired standard, by using my process, in the simplest manner, and much cheaper than by *any other* method. Address as above. 397

THE NEWBURGH

Orrel Coal Company,

Mines at Newburg, Preston County, W. Va.

Company's Office, No. 52 S. Gay Street, Baltimore, Md.

C. OLIVER O'DONNELL, Pres't. CHAS. MACKALL, Sec'y.

CHAS. W. HAYS, Agent in New York, Room 7, Trinity Building, 111 Broadway.

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It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York; the Brooklyn and Citizen's Gas Light Companies of Brooklyn, N. Y.; the Baltimore Gas Light Company of Baltimore, Md., and the Providence Gas Light Company, Providence, R. I.

Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.

294-1y n

THE DESPARD COAL COMPANY

OFFER THEIR SUPERIOR

DESPARD COAL

To Gas Light Companies throughout the country.

Agents, PARMELEE BROTHERS, No. 32 Pine street, N. Y.

BANGS & HORTON, No. 31 Duane street, Boston.

Mines in Harrison County, West Virginia.

Wharves Locust Point, Company's Office, 15 German St., } Baltimore.

Among the consumers of Despard Coal, we name: Manhattan Gas Light Company, New York; Metropolitan Gas Light Company, New York; Jersey City Gas Light Company, N. J.; Washington Gas Light Company; Portland Gas Light Company, Maine.

*** Reference to them is requested. 204-1y

NEW YORK AND CLEVELAND
GAS COAL COM'Y

Of Pittsburgh, Pa.

MINERS AND SHIPPERS OF

YOUGHIOGHENY GAS COAL.

This Company is prepared to furnish any amount of their justly celebrated, and acknowledged superior GAS COAL, to any point reached by railroad or navigation, on most favorable terms.

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W. H. WATERBURY & CO., General Sales Agents,
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CANNEL COAL

From West Virginia.

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GWYNNE AND HARRIS PATENTS.

This process has been fully tested nearly 50,000,000 cubic feet of Gas having been made under it, and fully demonstrating the fact that it is the greatest improvement ever made in the manufacture of Gas, either for Lighting or Heating purposes. With half a ton of Anthracite Coal 150,000 cubic feet of Gas per day is made from three benches, and the labor is so small that one man can attend three or four benches.

The process can be put into either Coal or Oil Gas Works (or where both Coal and Oil are used) at small cost, without any interruption to the working of other benches. The Citizens Gas-Light Company of Brooklyn, after using it for more than seven months, have found it not only far better, but actually *cheaper* than atmospheric air in making Gas, with the use of "petroleum and its products."

Further information, and terms of sale of rights will be given, upon application to the Company 348-1y

Portland Cement,
Roman Cement,
Keene's White Cement,

NUMBERS 1 AND 2.

From best London Manufacturers.

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GAS ENGINEER,

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355-

THE WAVERLY COAL AND COKE CO.

Offer for Sale the

YOUGHIOGHENY COAL

DOUBLE SCREENED,

from their Colliery at Smith's Mills, on the Youghiogheny River, thirty-seven and a half miles southerly of Pittsburgh. This Coal has the preference in Pittsburgh over all other YOUGHIOGHENY COAL for GAS PURPOSES.

The facilities of the WAVERLY COMPANY are unsurpassed by those of any other Company on the Youghiogheny.

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91 State Street, Boston.

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1852 **TROY, N. Y.,** 1876.

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OF THE GENUINE

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WITH EITHER

Long or D Handles.

WELL KNOWN AMONG

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PRICES REDUCED, and Shovels delivered in New York per lots of one dozen or more.

Orders solicited. 399-6

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ENGLAND,

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These goods are very superior to any yet made, and are specially suited for export, being so strong and well made.

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And Every Description of

GAS FIXTURES,

Also Manufacturers of

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ALSO,

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American Meter Co.—West 22nd st., N. Y., Arch and 22d st., Phil., 548 Washington st., Boston.... 1
Cast Iron Gas and Water Pipe—S. Decatur Smith, York and Moyer streets, Phila., Pa.....
Cast Iron Gas and Water Pipes—R. D. Wood & Co., Philadelphia Pa..... 16
Cast Iron Gas and Water Pipe—Jno. McNeal & Sons, Burlington, N. J.....
Franklin Foundry and Pipe Works—Jas. Marshall & Co., 23 Nineteenth street, Pittsburgh, Pa.....
Gas Valves (Chapman) 75 and 77 Kilby st., Boston, Mass..
Gas-Burners—C. Gefrorer, 248 North 9th st., Phila., Pa.
Gas Purification—St. John and Cartwright.....
Gas Meters, etc.—Harris, Griffin & Co., 12th and Brown streets, Phila., Pa..... 10
Gas Meters, etc.—Wm. W. Goodwin & Company, 1012 Filbert street, Phila, Pa..... 17
Gas Meter Manufacturers—Harris & Bro., 1117 Cherry st., Philadelphia, Pa..... 11
Gas Fixtures, Etc.—Mitchell, Vance & Co., 597 Broadway.. 7
Clay Gas Resorts, etc., etc.—J. H. Gautier & Co., cor Greene and Essex streets, Jersey City, N. J.
Gasholders, Etc.—Deily & Fowler, 39 Laurel st., Phila., Pa..
Gas Screen—James P. Mahon, Boston, Mass.....
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Petroleum Gas—J. D. Patton, Treverton, Pa.....
Patent Gas Exhauster—S. S. Townsend, Agt., 31 Liberty street, N. Y.....

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Cannelton Coal Co. of West Virginia—J. Tatnall Lea, 325 Chestnut street, Phila, Pa.....
Despard Coal Co.—Parmelee & Bros., Agents, 32 Pine st., New York..... 7
Gas Coals—Perkins & Job, 27 South st., N. Y..... 7
New York and Cleveland Gas Coal Company—384 Penn Avenue, Pittsburgh, Pa..... 6
Penn Gas Coal Co.—11 Merchants' Exchange, Phil. and 90 Wall street, N. Y..... 6
Peytona Cannel Coal—S. E. Low, 58 Broadway, N. Y..... 5
The Newburg Orrel Coal Co.—Chas. W. Hays, Agent in New York, Trinity Building, 111 B'way, Room 7..... 6
Tyrconnell Gas Coal—52 S. Gay Street, Baltimore, Md..... 6
Westmoreland Coal Co.—230 South 3rd Street, Phil. Pa.....
Youghegheny Coal—Perkins & Job, 27 South St N. Y.... 7

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Continental Works—T. F. Rowland, Greenpoint.....
Camden Iron Works, Camden, N. J.—Jesse W. Starr & Son.
Gloucester Iron Works—J. P. Michellon, Sec., 6 North 7th street, Phila., Pa..... 4
Mill Street Foundry.—Geo. Stacey & Co., Cincinnati. O.... 5
National Foundry and Pipe Works—Wm. Smith, Carroll, Pike, Smallman & Wilkins streets, Pittsburg, Pa.....
Oregon Iron Foundry—Herring & Floyd, 740 Greenwich street, N. Y..... 10
Pascal Iron Works—Morris, Taskar & Co., Philadelphia.... 12
Providence Steam and Gas Pipe Co., Providence, R. I.—H. A. Branch, Agent..... 3

WATER METERS, PUMPS, ETC.

Cast Iron Pipes for Water and Gas—Riley A. Brick, 112 Leonard street, N. Y..... 10
Valves for Water, Steam and Gas—Ludlow Valve Man'g Co., 240River street, Troy, N. Y..... 6

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B. Kreischer & Son, Clay Retorts, etc., 58 Goerck st., N. Y. 8
Cheltenham Fire Brick and Clay Retort Works—Evens & Howard, 916 Market street, St. Louis, Mo.....
Manhattan Clay Retort Works, 15th st., near Av. C, N. Y.. 8
Philadelphia Fire Brick Works, Vine and 23d sts., Phila.... 8

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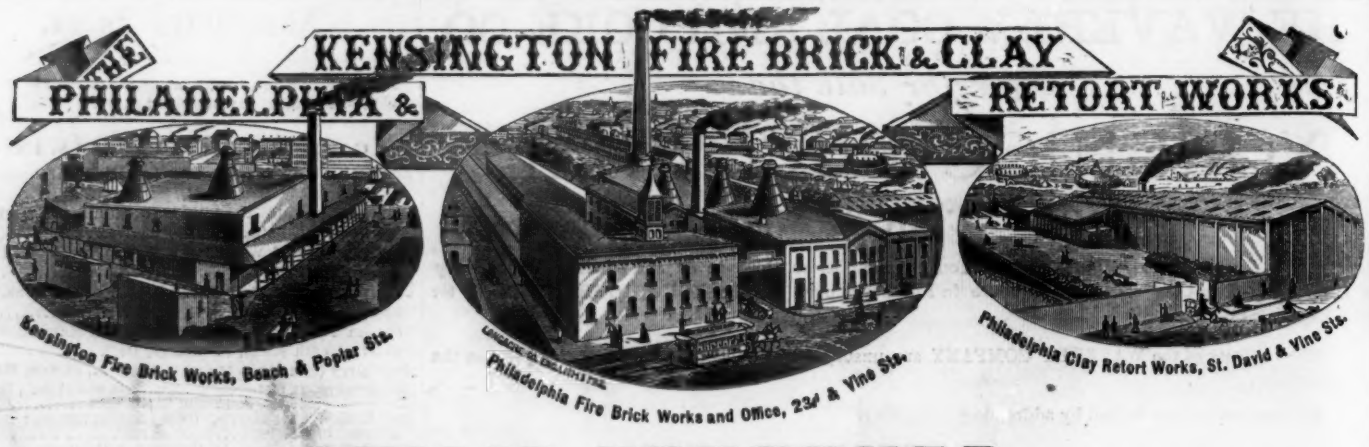
Patent Lamp Post—J. W. Graham, Chillicothe, Ohio, or A. M. Callender, office of this Journal.....

MISCELLANEOUS.

Analysis and Testing of Gas Coals—Prof. Henry Wurtz, 12 Hudson Torrace, Hoboken, N. J. 10
Architect and General Gas Engineer—William Farmer, 111 Broadway Room 95, N. Y.....
Brass Cocks, Plumbers' Materials, etc., etc.—McNab & Harlin Manufacturing Co., 56 John st., N. Y..... 7
Cements—S. L. Merchant & Company, 76 South st., N. Y...
Contractors for Gas Works, Etc.—Murray & Baker, Fort Wayne, Ind..... 2
Fodell's System of Bookeeping—A. M. Callender & Co., 42 Pine st., New York..... 1
Gas Engineer—B. S. Cholar, 914 Olive St., St. Louis, Mo.
Gas-Light Company of America, 63 and 64 Drexel Building, New York..... 2
Kidd's Gas Consumers Guide—A. M. Callender & Co., 42 Pine Street, N. Y.....
Massachusetts Institute of Technology—Samuel Kneeland Boston, Mass.....
National Coal Gas Company—H. P. Allen, 4 Warren street New York.....
School of Mines, Columbia College, East 49th st..... 9
Screening Shovels—Herring & Floyd, 740 Greenwich st., New York..... 10
Scientific and Practical Chemist and Geologist—Profetsor Henry Wurtz, 12 Hudson Terrace, N. J..... 7
Screening Shovels—G. W. Dean, 1288 Broadway, N Y..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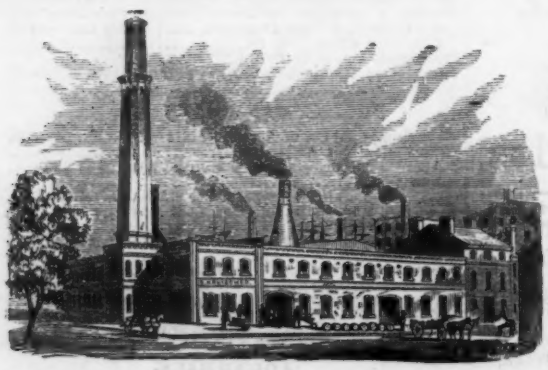

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Our experience in the manufacture of Pipe for a great many years, has enabled us in rebuilding to practically apply Machinery and Fixtures of the very best character, to insure *good work.*

We are now prepared to contract for this class of Castings under the most favorable terms.

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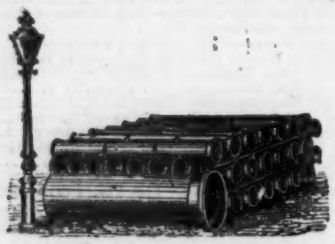

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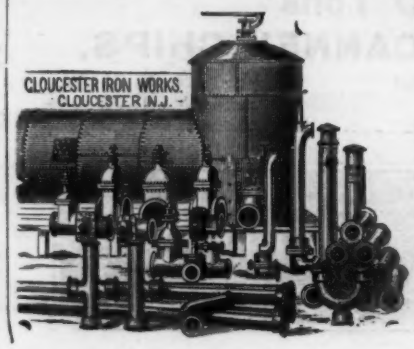

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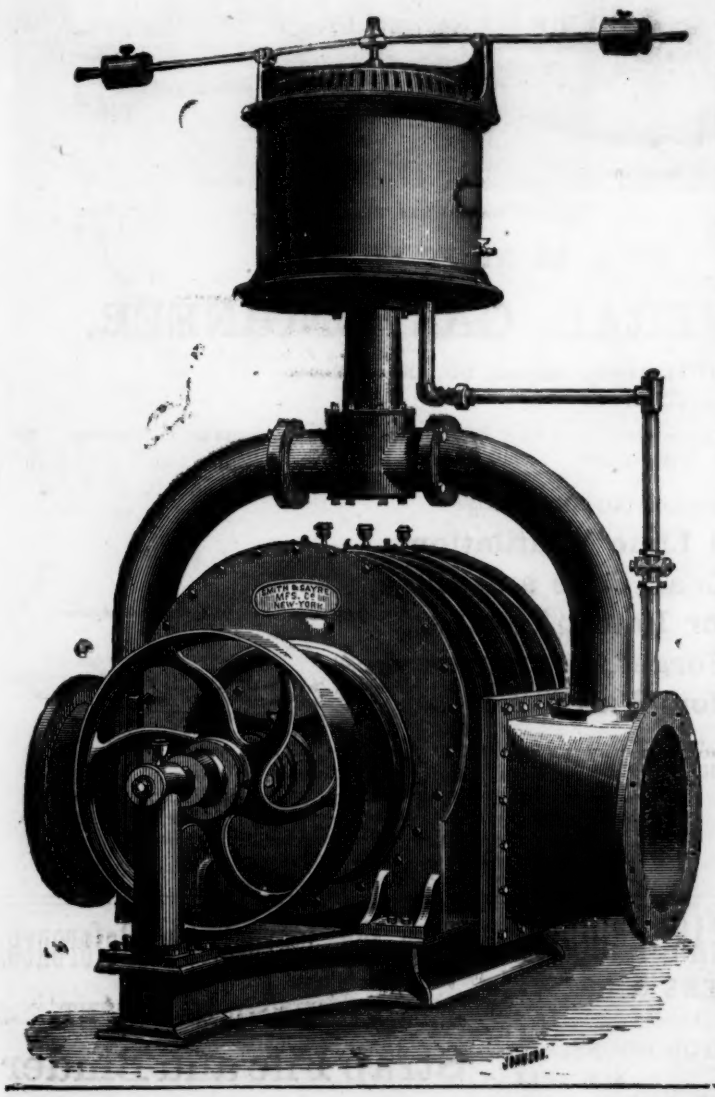

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AND

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An examination of the merits of these inventions as demonstrated by practical experience in a large number of Gas Works employing them, will not fail to convince the intelligent Gas Manufacturer of the great advantages derived from their use.

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CHARLES F. DEAN, Secretary

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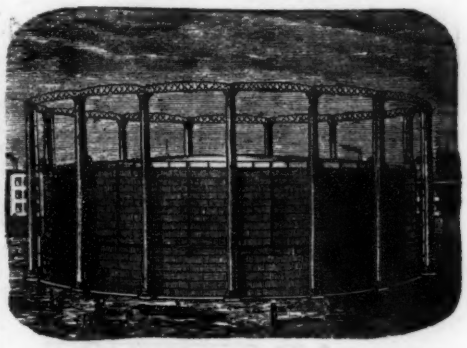

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OF ANY MAGNITUDE,

Condensers, Scrubbers, Purifiers, Retorts, Hydraulic Mains and all other articles connected with the Manufacture and Distribution of Gas, furnished with despatch. Plans and Specifications prepared, and Proposals given for the necessary Plans for Lighting Cities, Towns, Mansions, and Manufactories.

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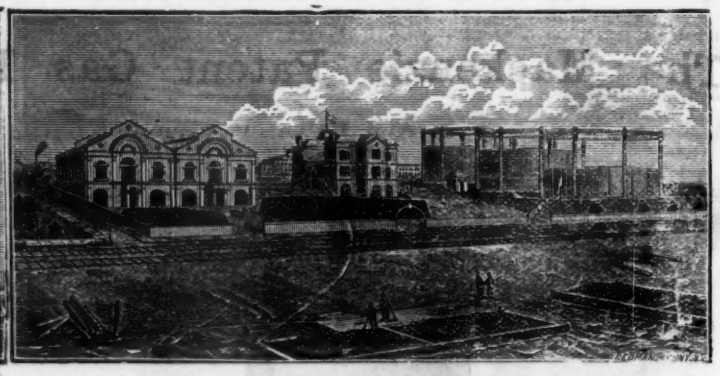

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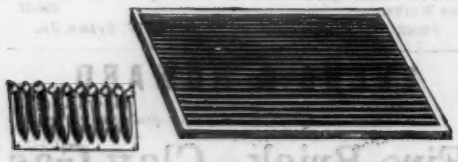

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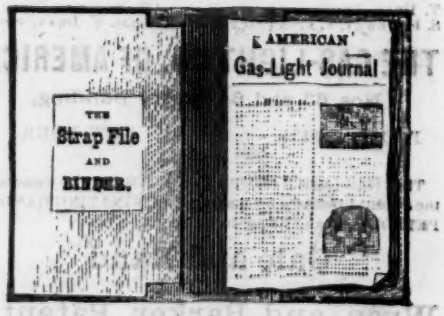

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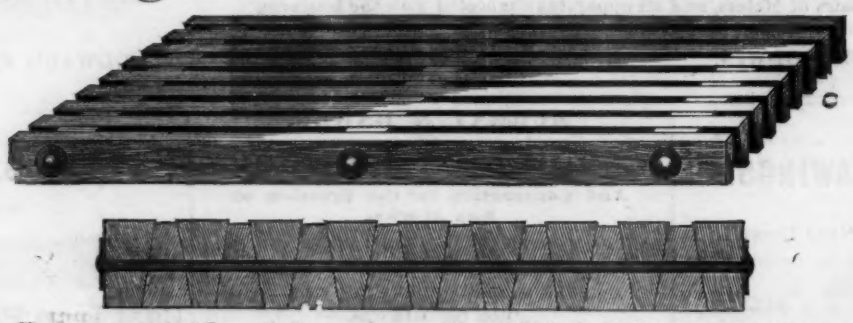

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Jersey City Gas Company, N. J.
St. Paul Gas-Light Company, Minn.
Cumberland Gas-Light Company, Md.
Hartford City Gas-Light Company, Conn.
Richmond Gas Company, Va.
McKeesport Gas Company, Pa.
Middletown Gas Company, Pa.
East Newark Gas-Light Company, N. J.
Binghampton Gas Company, N. J.
Zanesville Gas Company, Ohio.

New Orleans Gas Company, La.
Salem Gas-Light Company, Mass.
New Britain Gas-Light Company, Conn.
Rahway Gas-Light Company, N. J.
Trenton Gas-Light Company, N. J.
Elmira Gas Company, New York.
Erie Gas Company, Pa.
Columbus Gas-Light Company, Ohio,
Westchester Gas-Light Company, N. Y.
Santa Cruz Gas Company, Cal.
Lawrence Gas-Light Company, Kansas.
Salem Gas Company, N. J.
Indiana Gas-Light Company, Pa.
Peoria Gas Company, Ill.
Montclair Gas Company, N. J.
Williamsport Gas Company, Pa.
Wooster Gas-Light Company, Ohio.

Augusta Gas-Light Company, Ga.
Huntsville Gas Company, Ga.
Chattanooga Gas Company Tenn.
Murfreesboro Gas Company, Tenn.
Hagerstown Gas-Light Company, Md.
Hanover Gas Company, Pa.
Easton Gas Company, Pa.
Uniontown Gas-Light Company, Pa.
Coatesville Gas-Light Company, Pa.
Houston, Gas Company, Texas.
Wilkesbarre Gas Company, La.
Middletown Gas Company, New York.
Washington Gas-Light Company, Pa.
Princeton Gas-Light Company, N. J.
Newark Gas Company, Ohio.
Pontiac Gas-Light Company, Mich.
And numerous other Companies.